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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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Some Leading Articles in this Number.

A Manufacturing Machine Shop.
Sprocket Wheel Broaching Press.
Profile Steel.
Hydraulic Leathers.
Snap Piston Rings.
Advantages of Multipolar Electric Machinery.
A Magnetic Clutch.
Tool Steel in Machine Construction.
The Bicycle Industry as a Blight.
A Circus Ring Air Compressor.
French Tests of Steel.

NINETEENTH YEAR.

No. 31.
July 30,
1896.

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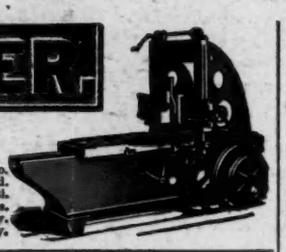

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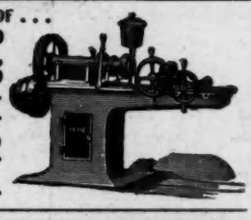

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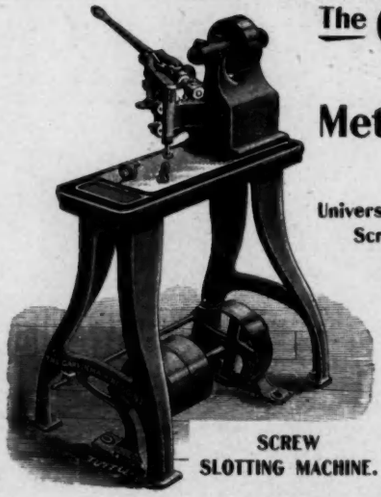

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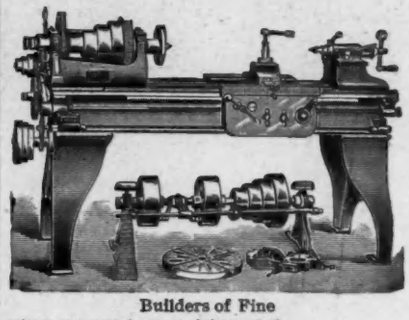

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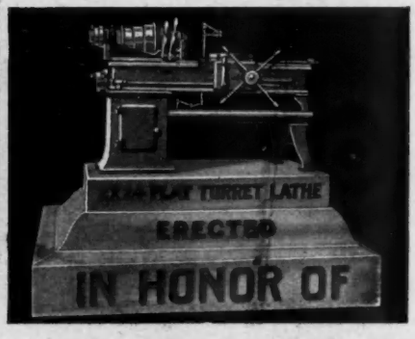

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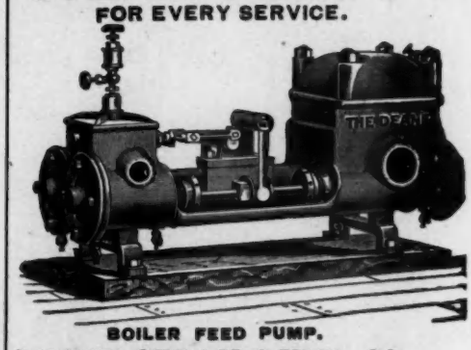

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NEW YORK, THURSDAY, JULY 30, 1896.

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A Manufacturing Machine Shop—II.

The problem set before the De Laval Company was, how to manufacture a machine of moderate size most cheaply, and how to establish this manufacture in a new and perfectly suitable building most quickly and with least cash outlay.

There are two ways of obtaining floor area; there may be a single continuous floor covering enough ground to give the needed square feet of floor surface, or there may be two or more floors one above the other. A single floor may be made almost as light as an open field, and it may also be overlooked at a single glance. A single floor requires more roof to the square foot of area, but the multiple floors require more wall than the single floor. Transportation is easier in horizontal lines than in vertical lines. It is impossible to have many floors all exposed to the superintendent's eye at the same time. A single floor may be lighted wholly from the top, and in such case the lighting will be best in the middle of the room. It is impossible to light a room as well from the sides as it can be lighted from above. Hence, if ground can be had at the same or a lower price per square foot than the construction price of a square foot of inclosed and roofed shop floor, a single floor is better than many floors, as being on one level, open to one view, capable of being lighted perfectly, increasing the expectation of salvage in case of fire, and, under certain wall conditions, being capable of extension in any direction.

It is true that single-floored shops may be of such widths and so roofed as to be very badly lighted, and also that a multi-floored shop may be built, like the watch shop at Marion, N. J., so narrow as to have an abundance of light from the sides; but a side south light is extremely objectionable, and a machine shop lighted from one side only is still worse; in point of fact, American machine-shop lighting is so generally bad that very few shopmen who read this can picture to themselves a shop in which no job need ever be "turned to the light" for inspection. The light of a machine shop should in all cases be reflected light; never the direct rays of the sun. Only the single floor can be perfectly lighted from the north alone.

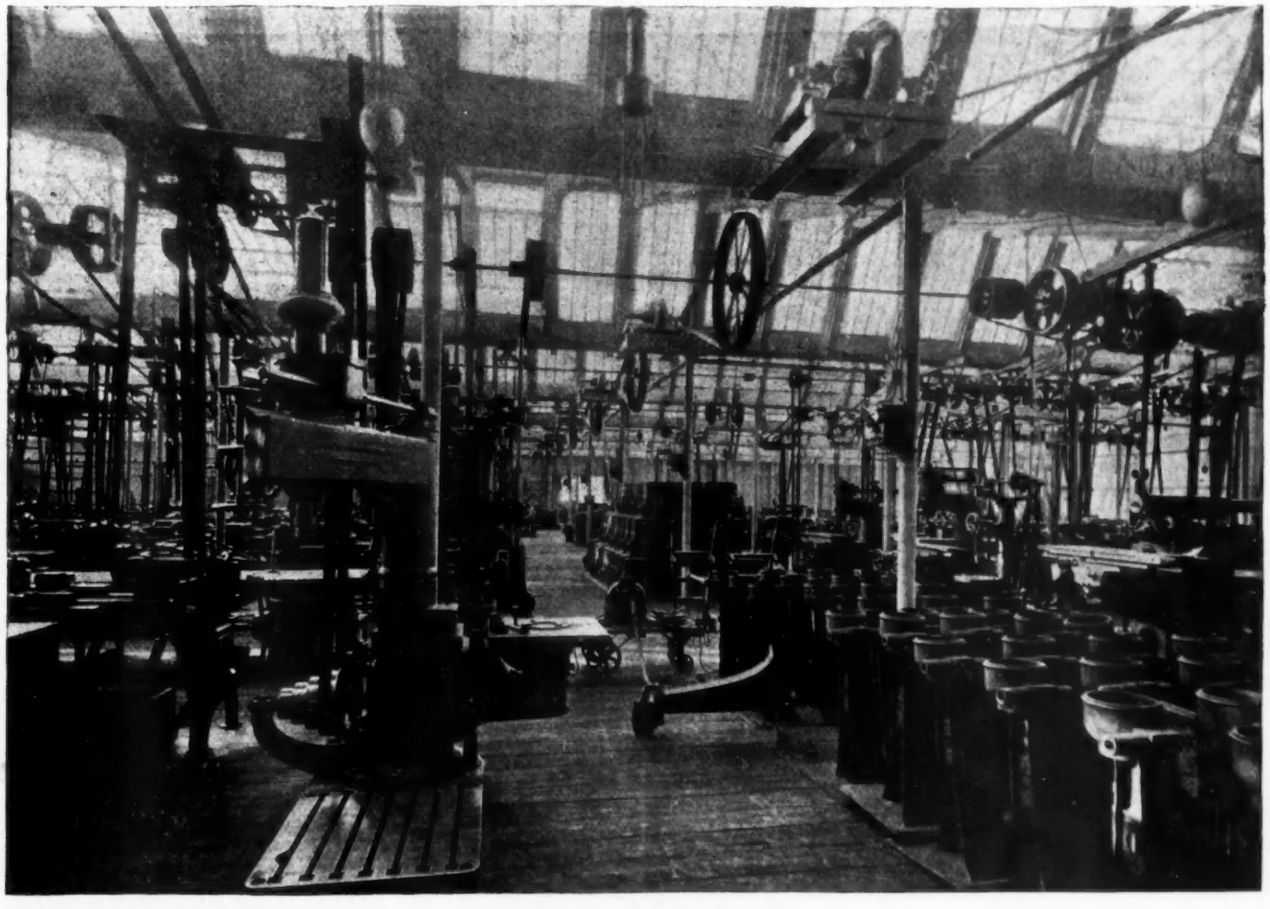

Fig. 8. INTERIOR VIEW OF SHOP.

These were the considerations which led the De Laval Company to select the single-

floor, saw-tooth-roof type of structure; a type which, though of all architectural structures least impressive to the eye, having in fact no beauty, is yet full of virtues. The company fully believed that large and rapid extensions of floor area would be demanded, and yet the commercial situation did not warrant the building of an extensive structure to be only in part occupied at first; hence, there was to be provided not only the best possible shop, but that shop was to be made extensible in at least two directions, and preferably in three directions, at will, and without deranging the economy of the running part while additions were in progress. Wood was therefore chosen as the material for the building, and a form was devised which, in connection with wooden sides of peculiar construction, permitted the indefinite extension of the shop in three directions without loss of advantage at any point. A long, narrow shop can be readily increased by additions at the ends, but the square floor has the important merits of openness to inspection and shortest lines of travel and transportation. The company, therefore, proceeded to plan a shop which, with the aid of wooden sides of special construction, could be made larger at any time and yet remain always approximately square in form.

The site came into possession of the company on a Wednesday, about May 1, 1892, and steps were taken to continue the production of separators after the Brooklyn shops were dismantled and before the new shop should be ready for use. The site was a strip of ground on the east bank of the Hudson River, nearly north and south in its greater extent, and having an old barn 30 x 60 feet on it. The following Monday the barn had been newly floored, equipped with a line of 2-inch shafting, windows put in, and two Putnam lathes, a Gould & Eberhart driller, and boiler engine, were in place, and the barn was transformed into a machine shop in active operation, with the usual accessories of vise benches, vises and supplies. Before the end of the week there were added a Brown & Sharpe No. 5 milling machine, No. 2 universal grinding machine and another 25-inch Gould & Eberhart driller, and by the 16th of June the original new shop building 100 x 100 feet was up and had in it 100 feet of line shaft, three more lathes, two Gould & Eberhart drillers, two Brown & Sharpe vertical boring mills, a tapping machine and 100 feet of benches. Meantime, parts for one hundred hand machines had been finished in the old barn and were now ready to japan and assemble; the new shop had twenty men at work. The Brooklyn shop had been closed on May 1st, and the Bloomfield, N. J., shops were closed August 1st, and both equipments removed entire to the new shops in Poughkeepsie. In November, 1892, the boxing shop in the new building was found too small, and the south two bays were extended 30 feet to the eastward. Early in the spring of 1893 the floor area was further increased by adding three new bays on the north, 150 x 20 feet each, and the original shop building was increased by adding 20 feet along the whole west side. In July, 1893, in accordance with instructions from the directors, the shop capacity was increased to forty or forty-four machines (according to sizes under construction) per day; and in August, 1893, a further addition of eight bays was begun on the north side, each 80 x 20 feet, and completed in the latter part of September, 1893. A little later a separate power house was put up, having an electric generating plant to supply the lighting and driving current for the entire concern; this was at work in January, 1894. Through all of these additions of floor area the shop went on without the least interruption, and the company's total sales of separators increased to fivefold the output in the best previous years. New methods of manufacture were devised and perfected, and labor costs for all the parts were very greatly reduced. In one important case the reduction was to less than one-twentieth of the former labor cost, and, although the form of the ma-

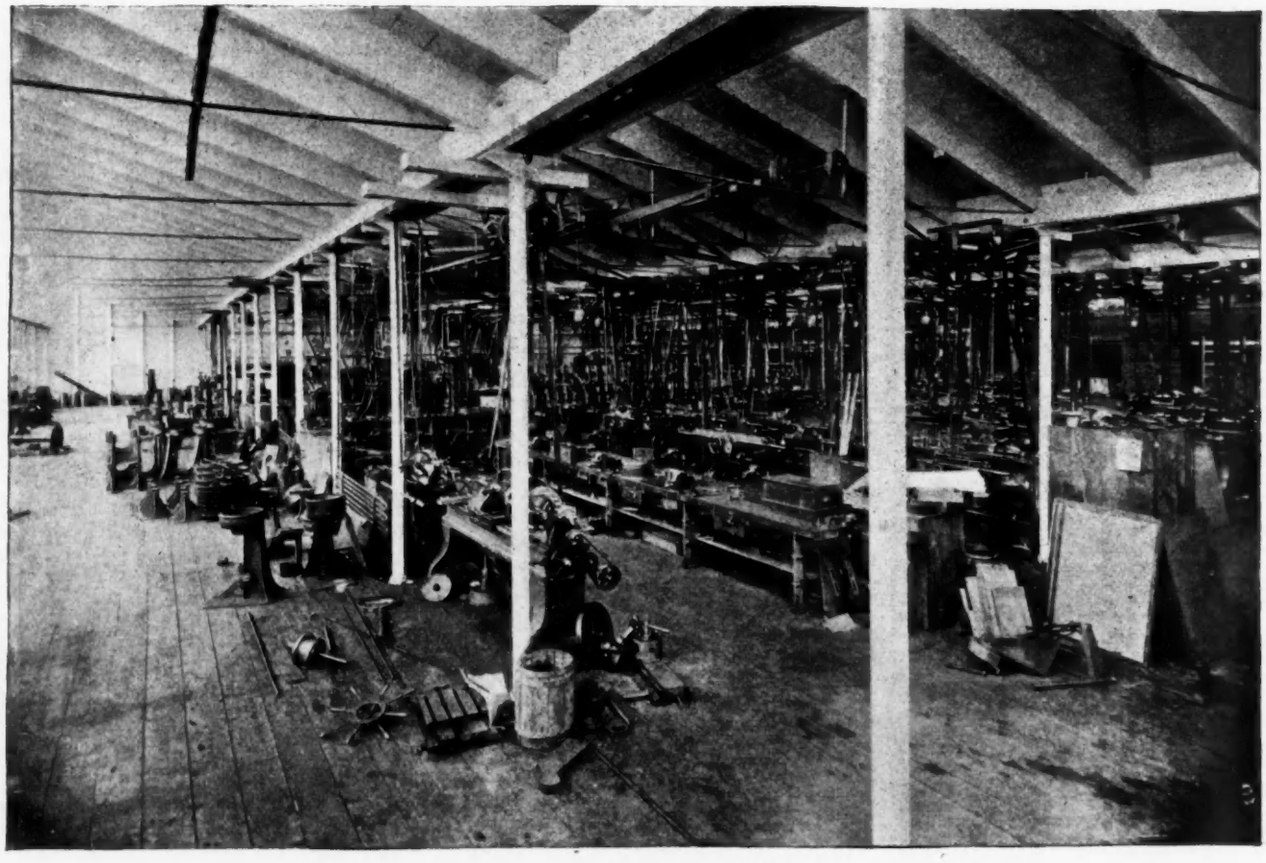

Fig. 9. INTERIOR VIEW OF SHOP.

chine and of each of its parts remained wholly unchanged, the accuracy of finish was greatly enhanced, so that the work turned out was at all points very much superior to the previous production. Figs. 8, 9 and 10 are interior views taken in 1893.

The plot on which the shops stand has 900 feet of water front; landing from the river with 16 feet of water at low tide, and a switch from the New York Central track which bounds the plot on the east; the plot is level, made ground, filled in with furnace slag and cinders for twenty years, making a perfectly firm rock-like basis, the general surface being about 2 feet above high tide. About midway north and south there is now a partly filled slip, crossed from the original shop to the north extension, 80 feet, by a walk and bridge level with the shop floors; at the time of building the north extension of eight 20-foot bays it was the intention to complete the filling of the slip and put in the four 20-foot bays needed to fill this 80-foot vacancy between the two buildings; this has not yet been done. All the machine work is done in the original south shops, and the finished stores, assembling and testing occupy the north extension, which is simply a structure of eight 20-foot bays, 80 feet east and west and 160 feet north and south, precisely the same in construction as the bays of the first shop and needing no separate description.

An extensible structure having varied members requires a unit of extension if the structure is to be homogeneous, or composed of similar parts when extended. Each "bay" of the shop, or each part covered by one complete section of the saw-tooth roof is 20 feet wide, north and south, and the foundation walls are 5 feet apart east and west, and the pillars supporting the gutter beams rest on the foundation walls, and so must be either 5 feet, or some multiple of 5 feet, from center to center, 10 feet being used. These pillars were originally intended to be of hemlock 8 inches square by 12 feet long; but in deference to the fire underwriters, right or wrong, the side-wall pillars only were finally made of wood, all of the interior pillars being of 4-inch iron pipe with 8-inch sole plates. Here, then, are the defining limits of the unit of extension: 20 feet=width of bay, north and south, and 10 feet=center to center of pillars, east and west. But in no case was any bay extended singly endwise or east and west; such single extension would have involved side walls and an irregularity of outline wholly at variance with ideas of symmetry. All additions were made in the form of extensions of the entire rank of bays on one end or the other, in multiples of 10 feet. The first addition was 20 feet on the east end of the bays, and the next 30 feet on their west ends, increasing the total east and west dimension from 100 to 150 feet. Each increase left the shop as it was before, a parallelogram, with pillars dividing the floor into "extension unit" spaces of 20 x 10 feet. This much decided, a 40-foot yellow pine staff, 2 inches square, was made (in one piece) and marked off as follows: One side, painted white, had the foundation walls, 5 feet center to center and 8 inches wide, on it, the walls in red bands; the second side had the floor beams 2 inches wide, and 15 inches center to center, on it in red bands; at each 20 feet of the third side were the 8-inch square pillar bases, one in the middle, and half of one at each end; the fourth side was marked with three 10-foot center-to-center lines, and each 10 feet divided in

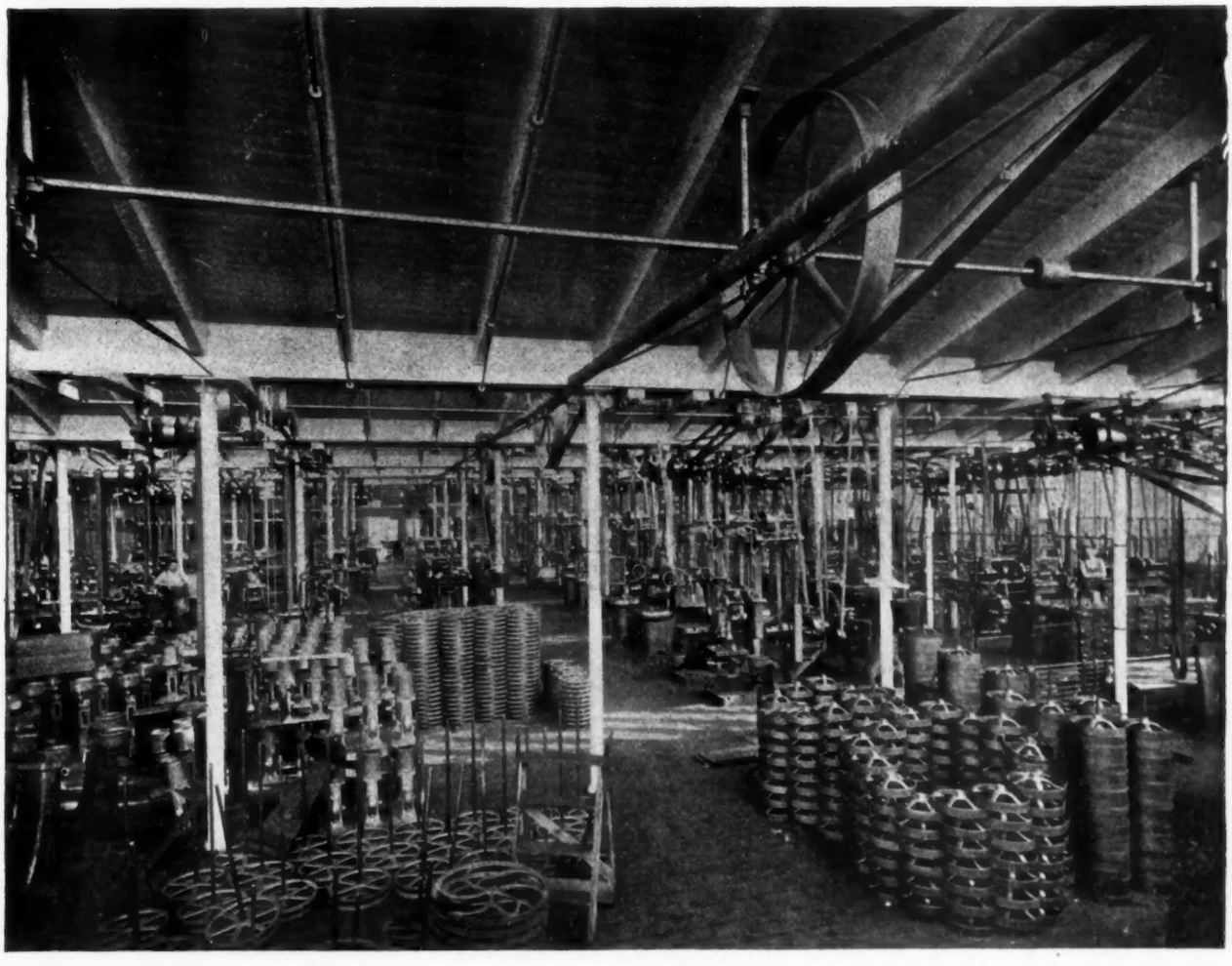

Fig. 10. INTERIOR VIEW OF SHOP.

three spaces of 40 inches each, and at each 40-inch division was a white band 5 inches wide, giving location of window uprights and roof beams and studding of store building, so that this 40 foot staff was the measure for the whole ground plan of the structure, and made it certain from the outset that the entire shop would gage to within a small limit when done, which might not have been the case had 2-foot rule measurements been used.

The north and south foundation walls, 5 feet center to center, 110 feet long, twenty-one in number, bounding a space 100 feet wide east and west, were—laid by the staff—18-inch wide stone walls for about 3 feet, or up to surface of ground, and on top of these stone walls 8-inch brick walls about 30 inches high were laid, so as to leave a clear space of about 30 inches between the surface of ground and top of brick foundation wall. The middle line of foundation wall, the eleventh, counting from either the east or west wall, was laid 5 inches higher than the extreme outer walls, each of the ten walls on either side being ½-inch lower than the next inside wall. This slope of 1 inch to 10 feet is kept in the floor and in the roof, and gives the gutter drainage, while all the similar uprights are of the same lengths. The slope of the floor line, 1 to 120, is not noticeable in the shop. On top of these brick walls 4 x 8-inch yellow pine wall plates were laid and leveled to take the floor beams 10 x 2 inches, 15 inches center to center, mostly 20 feet long, so that each beam lay on five foundation walls, broken joints, no two adjacent; on top of these, 2-inch hemlock plank, planed carefully to thickness and jointed, was nailed, thus making the whole floor level in north and south lines, but having a rise of 1 in 120 from the east and west sides to the center. This floor was a careful, level, smooth job, having the spaces between the floor beams filled solid with pine where the pillars were to stand, giving a direct pillar support on the foundation walls. After the whole shop structure was built, a false or wearing floor was laid over this true floor as follows: First, a double thickness of best building paper, tarred between, was put down, and over this a wearing floor of planed and jointed spruce, 1¼ x 6 inches, not matched, was laid east and west, and nailed only enough to hold; all square work, no diagonally laid flooring. The floor carries 1,500 pounds to the square foot without deflection beyond $\frac{1}{16}$ inch.

▲ ▲ ▲

Machine for Shaping Sprocket Wheels by Broaching.

The special milling operation called "gear cutting" has, it seems, become entirely too slow for making bicycle sprocket wheels, and we illustrate herewith a machine for broaching the teeth all at one stroke.

The sprocket blanks, after being bored and turned, are placed between collars on a work-stand which is mounted on the top of a heavy ram. This ram is driven by a coarse-pitch screw, which is operated by means of belt pulley and gearing with clutches and stop motion.

The broaching cutters are placed in a slotted cap having the requisite number of spaces corresponding to the teeth in the sprocket wheel. This cap fits into a guide ring, also mounted on top of the ram, and in this way the wheel and cutters are accurately centered. The cutters are very accurately made, can be sharpened by grinding on the face, and can be compensated for wear by adding new ones at the top of the cap.

After the sprocket blank has been clamped on the ram, the press is started by pushing the knob seen on the front of the base; this throws in the driving clutch and the press makes an upward stroke, carrying the blank past the cutters. An oil pump and tank with drain pipes is supplied, and this furnishes a copious supply of lubricant to a jet placed in the upper beam. By this means the cutters are thoroughly lubricated and the chips are washed down into the receptacle in the ram guide, from whence the lubricant is drained off into the tank below. The ram guide has openings on the side for removing chips.

After the blank has been passed through the cutters, the driving clutch is automatically reversed by a reversing rod and collars, and the ram then descends, and on reaching the bottom of the stroke is automatically stopped by reason of one of the collars on the reverse rod engaging with the bar to which the knob in front is attached.

The whole operation of starting, stopping and removing the work takes but a single minute of time, the press-driving pulley running continuously.

A pair of clamps and cap for holding cutters are required for each size of sprocket, but the cutters can be changed from one cap to another at will.

SPROCKET-WHEEL BROACHING PRESS.

Profile Tool Steel.

An English firm, Beardshaw & Son, Baltic Steel Works, have taken up the manufacture of profile steel, or special shapes of high-grade tool steel, from which many tools may be made with little or no expense of shaping or preparation. Tools for lathes, planers, shapers, slotting machines, drills, chisels, taps, bits and practically the whole list of such loose tools, may be made from the various sections without forging and by grinding only. European manufacturers generally have been quick to see the enormous advantages of this steel and are said to be ordering in large quantities. Metrical measurements seem to be adopted in the manufacture.

Referring to the accompanying cut, which has been redrawn and re-engraved from "The Ironmonger," the "Star" profile, Fig. 2, is carried in stock in various sizes from 8 to 70 millimeters (.315" to 2.75"), with a weight averaging 57 per cent. of that of round steel of the same diameter, and 43 per cent. of the weight of square steel of the same extreme dimensions.

Figs. 6, 7, 9, 10, 12 show various tools formed from this section. Fig. 7 is a chipping chisel. Two of the wings are ground away to the desired angle.

The fluted profile, Fig. 4, is especially rolled for lathe tools and drills, a lathe tool being shown at Fig. 8. The weight of this section averages 47 per cent. of that of round steel, and but 35 per cent. of that of square steel of the same outside dimensions.

Fig. 5 shows a drill made from the same section. Another section, called the "V," is supplied with a special holder in sizes up to 60 millimetres (2.36"), and is specially suitable for lathe and planer tools. The original section provides side clearance, and grinding gives top clearance.

The double profile for tools, of which Fig. 11 is an example, ranges in size up to 50 millimeters (1.97"). For planing and shaping it is possible to so grind the steel that each pair has four cutting edges, or, in other words, four tools are comprised in one.

With the twist drill profile, Fig. 1, which is made up to 70 millimetres (2.75"), twist drills are cheaply made. Rolled with the cutting edges well backed off, a very satisfactory drill is produced.

A reamer section, Fig. 3, is made into reamers, Fig. 13, by simply twisting, and the same section is equally suitable for taps. This section is known as the "three-wing," and is made in sizes up to 60 millimetres (2.36"), with an economy in weight corresponding to the reduction of section in comparison with a round bar.

▲ ▲ ▲

The largest ship-yards in the world are those of Harland & Wolff, of Belfast, Ireland. The works employ at present over 9,000 skilled workmen and apprentices. Since its organization the firm has turned out over 1,000,000 tons of ocean-going craft. The output of new shipping from Belfast last year was equal to that of all the rest of the world, excluding the United Kingdom. Messrs. Harland & Wolff are especially famous as the builders of the White Star liners.

▲ ▲ ▲

The output of crude rubber from the Amazon Basin has increased more than fourfold since 1870, and nearly thirty per cent. since 1890. The electrical industries and the bicycle are the two chief causes of this enormous increase. Fears of a rubber famine are not, however, as great as heretofore, as new sources of supply are being constantly discovered.

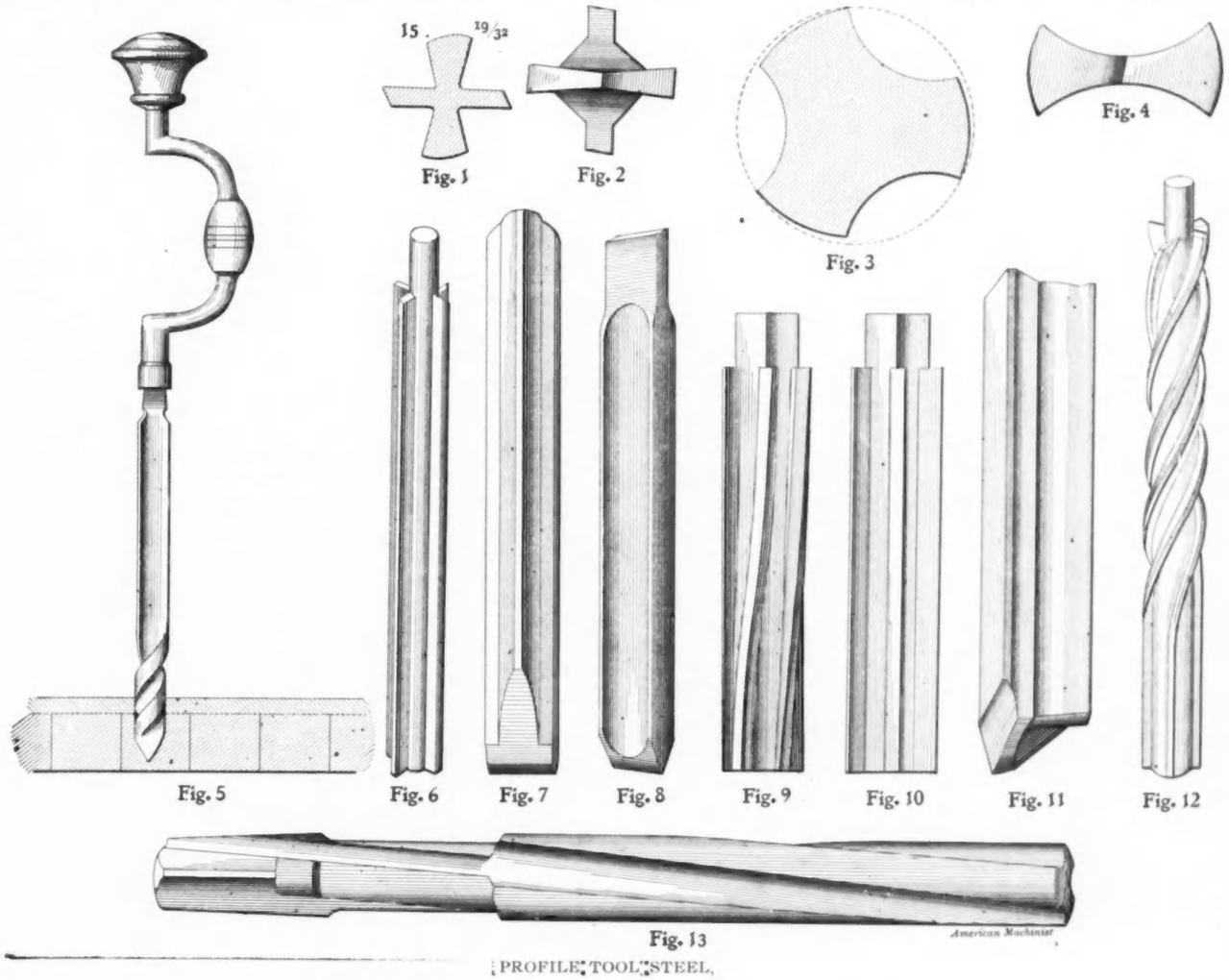

Fig. 1 Fig. 2 Fig. 3 Fig. 4

Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9 Fig. 10 Fig. 11 Fig. 12

Fig. 13

PROFILE TOOL STEEL.

Snap Piston Rings.

BY F. A. HALSEY.

The snap piston ring has been winning its way to extended use for a considerable time. Looked upon at first as somewhat cheap and nasty, and at best suited for small engines only, it has been found to be, in fact, all that is required for tightness, and is now used in engines of considerable size as a matter of course. Of how large sizes it has been used it would be interesting to know. I have put it in engines with 28x60 cylinders with entirely satisfactory results, so far as I have been informed, and should not hesitate to use it in considerably larger sizes than this. Its action is undoubtedely that of "steam packing," the ring being held to the bore of the cylinder mainly by the pressure of steam behind it, and not by its own elasticity as often supposed. If the piston were made with a follower, and the joints were carefully scraped, it is perhaps conceivable that the steam could be kept out of the space behind the ring; but made as they usually are—a simple lathe fit in a solid piston—such a result is not possible. It is, moreover, the practice of some to turn the ring a thirty-second narrower than the groove, in order to reduce the tendency to stick fast, and such rings are found to be as tight as those turned to fit. The action under steam pressure is shown in Fig. 1. The steam coming freely over the top of the piston flange, forces the ring to the advance side of the groove, thereby opening the follow side and admitting pressure below the ring, thus giving full pressure under and behind the ring. The steam also endeavors to creep between the ring and the opposite side of the groove, and also between the ring and the cylinder wall. As Professor Robinson has shown by conclusive experiment, the pressure in such a joint starts at full pressure and gradually falls to nothing at the leaving edge, the average pressure in the joint being probably somewhat less than half the applied pressure. The pressure being greater below and behind the ring than on the other sides, it remains forced outward and forward by the steam. That this is the real action was shown in a striking manner in a discussion of the Railway Master Mechanics' Association some years ago, in which it was the almost universal testimony that these rings wore the cylinder most at the ends, which can be explained only by reference to this action.

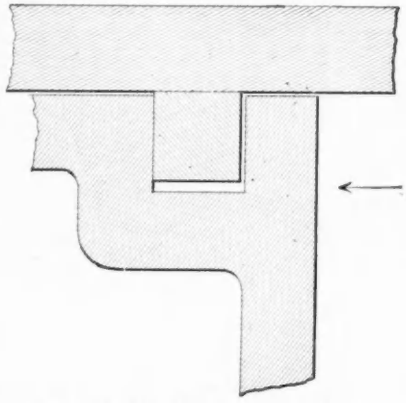

Fig. 1. SECTION OF SNAP RINGS.

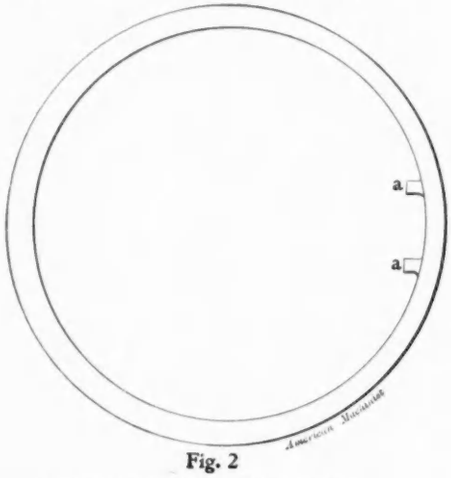

Fig. 2

CONSTRUCTION OF SNAP RINGS.

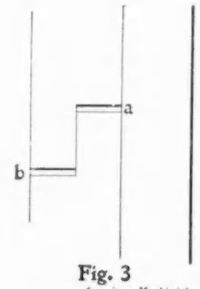

Fig. 3

USELESS LAP JOINT.

As to the discussion of concentric versus eccentric outside and inside, I have always made them eccentric, though if properly made in other respects I do not believe it a matter of much importance. One disadvantage of the eccentric shape is that such rings are lightest on the gap side, and tend to work themselves around with the gap on the upper side of the piston where the steam blows freely through. In any case, however, a pin should be placed in the groove near the bottom to enter the joint of the ring, so that this consideration is of little importance.

These rings are usually turned a little larger than the bore of the cylinder, when the gap is cut out and they are sprung into place. If of the concentric style they cannot be round when in place, and elaborate calculations have been made to determine the proper thickness of the rings at different points in order to insure their being a true circle when in position. Such a method can give but an approximate result at best, and the following method of construction will give much better results and in a much simpler manner: In this plan the ring is cast large, with two lugs *a a*, Fig. 2, on the inside. After being cut off and faced to thickness, the gap is next cut out. The ring is then sprung together by a clamp on these lugs, when it is strapped to a face plate, or, better, clamped between two flanges of a special fixture, and is put in the lathe and turned to the true size of the cylinder bore. When the clamp is relieved, the ring expands again, but not to a circular shape; but when put in its place in the cylinder, it resumes its circular form, or very near it, and is a fit all around, as it should be. To secure the best results the ring should be released from the face plate

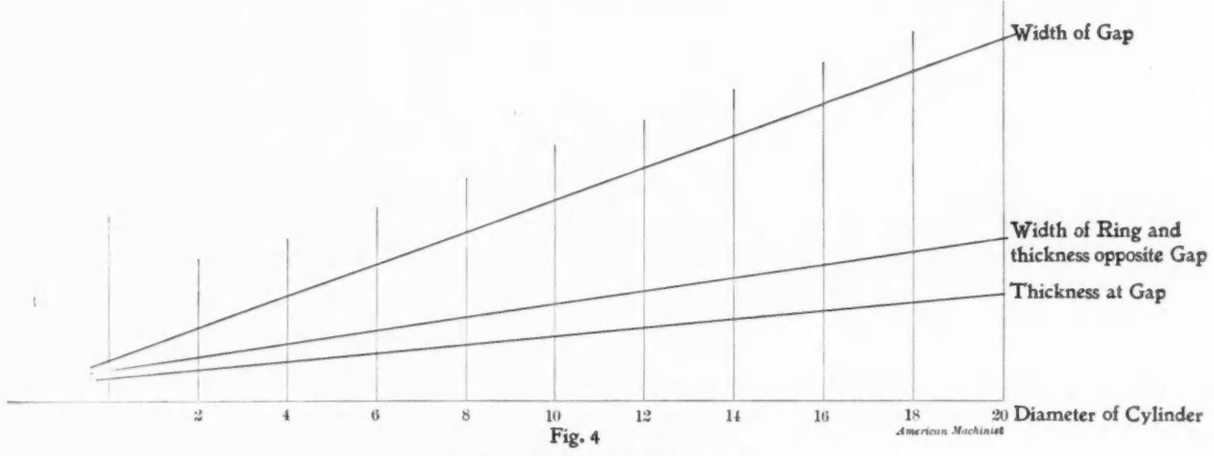

Fig. 4

PROPORTIONS OF SNAP RINGS.

and be reclamped before making the finishing cut.

A similar wrinkle is of assistance in making the pattern. If the pattern is turned up round, it will be found when the gap is cut out and closed up, that the casting will have so departed from its circular shape that, unless excessive finish has been allowed on the pattern, the ring will not clean up at all points, and where the cut is heavy the ring will be thin when turned. To obviate this, make the pattern of pattern size with usual finish, as though the ring were to be solid and of the same size as the cylinder bore. Next saw the pattern apart where the gap of the ring is to be, and insert a piece the size of the gap. This will spring the pattern outward to a non-circular form such that when the casting is cut and sprung inward for turning, it will be nearly a true circle in the rough, with a fairly uniform allowance for finish all around and with a gradually tapering thickness, as intended.

These rings are sometimes made with a lap joint, as in Fig. 3, under the impression that such a joint will be tight against the steam. This is a fallacy, as a moment's consideration will show. The steam entering at *a*, passes below the ring and escapes at *b*, just as freely as with a plain-cut joint. The joint should, however, be cut at an angle to avoid streaking the cylinder.

Fig. 4 gives a scale of dimensions for these rings, from which rings have been made in large numbers. It will be noticed that the gap is much wider than is usual. This is an advantage which the method of construction described makes available. With the usual construction, the gap is made small to reduce the distortion of the ring when inserted in the cylinder; but with the construction here recommended, this consideration no longer holds, and the gap may be made wider with the obvious advantage, especially in the smaller sizes, of less danger in springing the rings in place. The diameters are given quarter size; the other dimensions full size. This scale has been used between eight and twenty inches diameter only; but I know of no reason why the dimensions should not be made in proportion for a considerable range each side of these limits.

The inside of the rings is left rough—or, at most, merely filed to get rid of the sand.

▲ ▲ ▲

An accident occurred recently to the British torpedo-boat destroyer "Desperate" upon her trial trip. She ran over a measured mile six times at 30 knots per hour, when an explosion occurred in the engine room. It was found that the starboard intermediate crosshead had broken, and that as a result the piston had knocked out the bottom of the cylinder. Three men were badly scalded.

Hydraulic Leathers.

The firm of Fleming, Birkby & Goodall (Limited), Manchester, England, have recently issued a pamphlet on the above subject, and we condense from it the following:

Various substitutes for leather have been tried for hydraulic service, but always

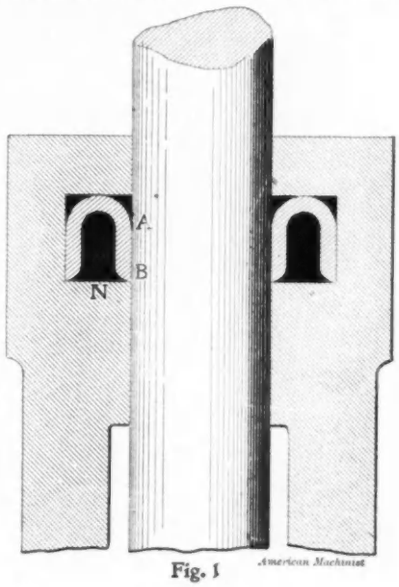

Fig. 1

U-LEATHER.

without success. The question how to make a good leather, and how to use it when made, although of prime importance, is not easy to answer without practical experience. Tanning and preparing the leather must be considered in connection with the engineering problems. One may know the kind of leather required and how to prepare it, while another will know the kind or shape of mold to use, and the one who knows how to produce any required shape may still not know what shape will serve the purpose best.

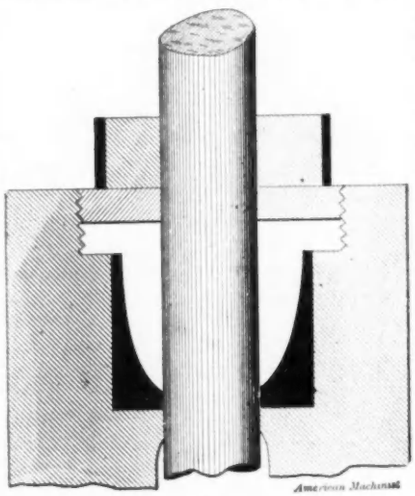

Fig. 2

BILLYCOCK LEATHER.

A cupped or U-leather, Fig. 1, forms a self-tightening packing, and is very generally used. The water gets behind the leather and presses it tightly against the ram; the friction occurs mainly at *A*, increasing as the water pressure increases. There is not much friction between *A* and *B*, and the efficiency of the press is little altered by making *A B* greater or less. A shallow leather is the best. The part *A B* is constantly alternating between tension and compression, and is liable to crack if the leather is not good. The shallow leather works as well as the deep one, and less straining of the leather occurs in blocking or molding it.

Fig. 2 shows a form of leather frequently used for pump plungers for high pressures. It is sometimes called (in England) the "hat" or "billycock" leather. It is fixed in a gland or stuffing box at the top of the barrel to keep the water pressure from escaping. This form has the disadvantage of creating more friction on the plunger or leather itself than the U-leather, on account of its greater rigidity.

Cup Leathers.

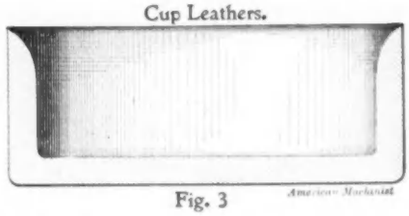

Fig. 3

It is cheaper, but the U-leather lasts longer.

Cup leathers, Fig. 3, are largely used for hydraulic jacks, lifting pumps, pump buckets, etc.; they are often called "bucket" leathers. They are not usually used for the higher pressures. Fig. 4 shows a cup leather in position on a hydraulic jack ram.

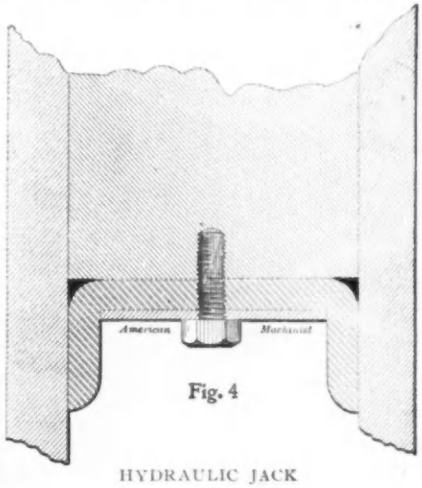

Fig. 4

HYDRAULIC JACK

The presence of grit in the water or oil that is used with these leathers is bad and causes the leathers to wear away rapidly. If the leathers are not kept constantly under pressure the grit gets between the leather and the ram when the pressure is let off, and when the pressure comes on again the grit wears the leather and also

scores the ram. A relief valve may be put in the pipe from the pump to the accumulator, and the suction valve left open, in this way always keeping the pressure on the leather and saving considerable of the wear.

Fig. 5 shows a suitable way of packing

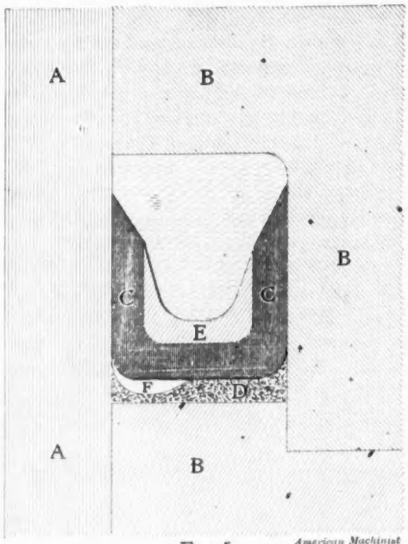

Fig. 5

ACCUMULATOR PACKING.

accumulators. *A A* is the working ram in cylinder *B B*; *C C* is the U-leather which is secured by the wrought-iron gland *B*, recessed into cylinder and pressing against a layer of hemp *D*. To keep the leather open, a ring *E*, either of brass, braided hemp or flax, is introduced. *F* is the brass guard ring to save the leather at the bending of the cup if necessary.

There is not much difficulty in fixing leathers in presses that have a gland or stuffing box, it being only necessary to

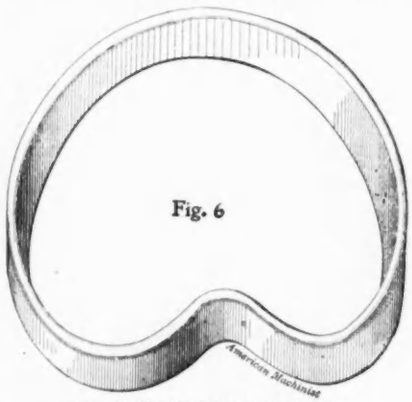

Fig. 6

TO GET THE LEATHER IN.

take out the ram, unscrew and take off the gland, and drop the leather on to its seat, but there is some little difficulty in fixing a leather into a cylinder with a squared-out recess a few inches down the cylinder. The diameter of this groove is, of course, greater than the diameter of the bore of the cylinder, and the outside diameter of the U-leather is, or should be, the same as the recess or groove, and consequently greater by (at the least) one inch than the cylinder bore; the difficulty is in reducing the diameter of the leather so as to enable it to pass down in the groove without injury. This is done by bending the leather inward with the thumbs of both hands almost to shape of Fig. 6, when it will considerably reduce the diameter. It will then pass down the cylinder, and a little pressure will shape it into its place in the groove. It is important and essential that the leather should be well rubbed with tallow before putting in, and the tallow well worked into the leather by rubbing and working the leather about with the hands. A good plan is to fill the inner space of the leather with neatsfoot oil or sperm about an hour before putting in. Never use mineral oil for rams or cylinders; being thin it runs away quickly, and also renders the leather rotten and pulpy. There is no economy in using cheap lubricants, especially in the case of hydraulic work.

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Some Lathe Kinks—Roll-Grinding—Cutting Bolts—Making Sketches.

BY JAMES F. HOBART.

A very handy way of adapting ordinary wood-turning tools for use in an engine lathe is shown by Fig. 1. It is a home-made affair, which can be constructed in a few hours out of common iron and tool steel. The shank *a* fits the tool-post of the lathe and the end is drilled to receive a bolt, the head of which is mortised, as shown at *b*, to receive the ordinary wood-turning gouge *c*. The gouge is held in place by the set-screw, as shown, and may be conveniently removed for sharpening or for making any necessary adjustment. The nut which screws *b* to socket *a* may be loosened and the gouge turned to any required angle, so that it may be made to cut or scrape the work at will. The mortised bolt *b* may be removed entirely and another bolt put in its place, carrying a straight mortise in the head, so that a chisel may be inserted for finishing work very smoothly. Several tools of this character are very handy around a lathe, not only for turning wood, but for holding small tools for turning brass or for interior work in large circles.

A rig for grinding rolls where there is no overhead grinder attached to the lathe, is shown in the sketch Fig. 2. Two lathes are shown, the roll to be ground being placed between centers at *a*, and another lathe which drives the grinder being placed at *d*. It is customary in the shop where this device is used to make use of two lathes, which stand side by side, about 10 or 12 feet distant from each other. A plain wooden roll about 10 inches in diameter, and fitted with iron gudgeons, is located as shown at *c*. This roll is hung in a pair of ordinary overhead or drop hangers, which are turned upside down and lag-screwed to the floor. In the plan view the pulley *d* is represented as being driven in the auxiliary lathe, the belt passing over roll *c*; the idler *e* is used to prevent the lower fold of this belt from scraping against the lathe bed. The

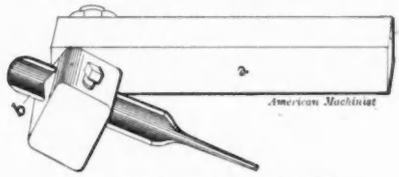
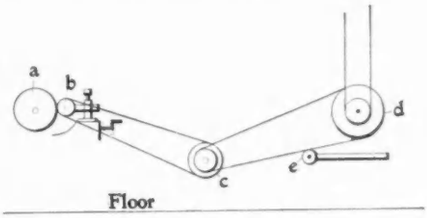


FIG. 1. HAND-TOOL HOLDER.

grinder *b* is fixed to the slide rest in the usual manner, and the roll *a* is turned in quick time, and as accurately as it is possible to do this kind of work upon a cylinder placed between centers.

It has always been a mystery to me as to where the wood pulley gets its holding power. There seems to be no reason why a wood pulley should not slip upon a



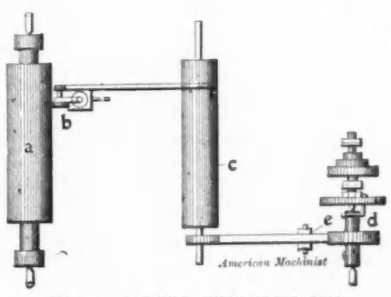


Fig. 2. A ROLL GRINDING RIG.

shaft, and there is reason for its slipping when heavily loaded; and it has been found necessary in the experience above mentioned to replace all pulleys 4 feet or more in diameter with those having iron centers and arms, the rim alone being made of wood.

In some instances it has been found necessary to cut a keyway in the wooden hub of the pulley and put a key in the shaft in the ordinary manner. This is a temporary makeshift at best, and when a wood pulley begins to slip, the only correct way out of the difficulty is to replace it as soon as possible with an iron center pulley keyed to the shaft. I have a good deal of respect for a wood pulley; for light work it leaves nothing to be desired; it can be taken off or put on a shaft in a very short time. But, as stated, for anything over 48 inches in diameter, especially with belts 8 or more inches in width, the wood pulley cannot be depended upon to hold without slipping to a considerable extent. Loose wood pulleys have also been receiving considerable atten-

tion from the writer. Makers of these pulleys supply a composition bushing which is split and clamped together in the hub of the split pulley, and provided a good fit is secured when the pulley is first put up, this device will run fairly well; but I believe that all loose pulleys, and wood loose pulleys in particular, should be fitted with a good set of metalline bushings. These bushings are expensive, but they do the work pretty well.

The making of sketches is followed to a considerable extent by engineers, foremen and other mechanics, who are constantly being called upon to express their ideas in a brief and clear manner. The old saying that any sketch is better than no sketch at all contains a good deal of truth, and the man who has the ability to make a very clear free-hand sketch possesses a higher market value for his time than does his brother workman not favored in this manner. A great many mistakes might be avoided if sketches were even more freely used. No matter how minutely a piece of work may be described to the machinist who is to execute it, there may exist a difference in understanding between the two men. The machinist may think he understands it clearly, and yet may not grasp even the vital principle of the work. On the other hand, the engineer may think he has made it perfectly plain to the workman, while a thoroughly and totally different understanding from the one meant has been imparted.

Speaking of foremen reminds the writer of a remark which he heard dropped by the superintendent of a well-known factory very recently. This superintendent, in speaking of a foreman, said that the chief office of a foreman was to get thirty-six hours' work per day out of two men, without hurting the men. There is a good deal in this statement, and the foreman who can do it to the letter is certainly worth hiring at a good salary.

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Text-Books Again.

The faulty arrangement of many text-books, to which we devoted an editorial recently, is beginning to attract attention among educators.

We are in receipt of a manuscript copy of a paper entitled "Specifications for Text-Books" by Prof. I. O. Baker, of the University of Illinois, and read before the recent Springfield meeting of the Society for the Promotion of Engineering Education. The paper is too long for publication in our columns; but there can be no doubt that were its recommendations followed by the authors of such books, many an irritating thorn would be removed from the path of those who turn to the books for assistance.

A great merit of the paper is that it does not confine itself to glittering generalities, but comes down to such specific recommendations as those regarding notation and arrangement, both of subject matter and typographically, to indicate the relationships of subjects and to make reference easy.

Referring to the necessity for clear and concise language, Professor Baker quotes from Ruskin, that "one of the greatest feats of the human intellect is to see something clearly and then to describe it in plain and simple language." Again we quote from the paper before us: "Writers of technical books appear to be more concerned is showing the depth of their own learning than with the method of imparting knowledge." Models for all time of the use of language can be found in the books of Professor Tyndal, which require a search to find a word of more than three syllables, and whose clearness of expression is probably superior to that of any other modern scientific writer. If more authors of text-books would study the Tyndal model, their own reputations would gain by it as much as their students would profit.

Not many of our readers will ever write books; and as the paper is intended for those who do write books, it is unnecessary for us to make extended extracts from it. The following paragraph is, however, so entirely in line with our editorial of March 26th, that we cannot refrain from quoting it, if only as an indorsement of our own words:

"All tables should carry at their heads an explanation of their contents. Astonishing as it may be, it is not unusual to be compelled to search the text, line by line, for the meaning of some table. It is needless to say that such a table is of little or no value, unless the reader supplies the necessary explanation by his own hand upon the face of the page. Each column of the table should contain a statement of its contents or an explicit reference to such a statement."

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An Elaborate Churn.

Thos. B. O'Neil, the American Consul at Stockholm, Sweden, says, in a special report:

"A machine invented by Mr. Salenius, a Swedish engineer, makes butter in about a minute from sterilized milk direct. Milk is heated in the sterilizer (or "Pasturine," as it is called) to 160 degrees Fahr., and runs into the cream-skimming chamber of the machine. As the cream is skimmed it rises into the churning chamber, being cooled down to 60 degrees in its progress by means of very small cooling frames, through which ice water constantly passes; these revolve with the skimmer at the rate of 6,000 revolutions per minute.

"The cream is forced into a tube perforated with tiny holes, through which it emerges with great force upon each fresh layer of cream that rises, converting it into butter by concussion. The butter, thus formed by granules, emerges from a spout into a tub, mixed with buttermilk. The butter is then taken out and passed through a butter worker, which squeezes out most of the buttermilk remaining, after which it is placed on ice for two hours, and then worked a little more and made up."

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The Biggest Steel Works.

The "Eisen Zeitung" gives the following details concerning the world-renowned Krupp Works at Essen, Westphalia:

"There are two steel works with fifteen Bessemer converters; four steel works with Siemens-Martin open-hearth furnaces; iron, steel and brass foundries; puddling, melting, reheating and annealing furnaces; draw benches; a hardening and tempering department; file manufactory; rolling mills for plates, rails and tires; railway spring and wheel manufactory; steam hammers, forges, axle-turning shop, boiler shop, engineering and repair shops. Besides the above and many other departments, at Essen, connected with the making of cannon, there are steel works at Annen, in Westphalia, three collieries in Westphalia, besides participation in several others; 547 iron mines in Germany; various mines at Bilbao, in Spain; four iron works including one at Duisburg, one at Engers, one at Neuweid and one at Sahn; various quarries of clay, sandstone, etc.; four steamers, and artillery ground at Meppen, Hanover. The property owned extends over 974 hectares (2,406 acres); and the number of hands employed in mines and steel works is 25,301. There are altogether 1,500 furnaces of various kinds, 3,000 engines and machine tools, 22 roll trains, 111 steam hammers, 2 hydraulic presses, 263 stationary boilers, 421 steam engines, representing together a force of 33,139 horse-power, and 430 cranes, including travelers, having a collective lifting power of 4,662 tons. The total length of the shafting is 8.8 kiloms (5½ miles), and that of railways, standard and small gage, 85 km. (53 miles), worked by 32 regular trains, with 33 locomotives. The annual consumption of coal amounts to 1,253,161 tons, and that of lighting gas to 12,000,000 cubic meters (423,799,000,000 cubic feet), while there are 573 arc and 1,804 incandescent electric lamps."

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The railroads running out of New York City, for the first two weeks of July carried 75,000 bicycles for outgoing passengers. The Erie road alone carried out 5,000 wheels on July 4th. As the wheels are received and checked in New York, and have first to be carried across the river by ferry before they are put on the cars, the labor involved must be imagined. The railroad people would seem to be deserving of some sympathy, at least until they are broken in to the new order of things; and the above single fact of travel suggests how the machine maker, the machinist, is again making his mark broad and deep upon the habits and arrangements of the people.

ELECTRICAL MACHINERY.

The Advantages of the Multipolar Type of Electric Machinery.

BY WM. BAXTER, JR.

In the days previous to the advent of the dynamo, it was customary to construct electric machines with many poles, but when the modern development of the electrical industry began it was found that two pole machines could be made that would generate just as powerful currents as those of the multipolar type. As it is the natural tendency of machinery builders to favor simplicity, the less complicated bipolar machines became the favorite. After awhile the more far-sighted among electrical engineers began to see that an increase in the number of poles would be advantgeous, notwithstanding the apparently greater complication. From that time onward the latter style of construction began to grow in popularity, and to-day is used almost exclusively for large machines, and to a very considerable extent even in the smaller sizes.

The advantages of the multipolar type are quite numerous, and so clearly defined that they can be easily pointed out; the disadvantages are very few, and of such a doubtful character that it is a debatable question whether they are disadvantages or not.

Most of the points of superiority of this class of machines are due to the fact that, under the same conditions, the output per pound of weight of machine can be made much greater than with the two-pole type. This advantage of an increased capacity per unit of weight can be utilized in several ways; thus, it becomes possible to improve upon the results obtained with the bipolar construction in any direction in which a gain may be desired.

Every engineer will admit that if more work can be obtained from a given weight of machine, running at the same velocity, by a simple change in the design, this change is desirable and valuable; but there are many, even among electrical engineers, who cannot fully comprehend why the mere increase in the number of poles should render such results possible, and a few others are even disposed to assert that they are not possible. In the following it is proposed to show clearly why an increase in the number of poles will cause an increased output per unit of weight. This fact being established, it will be a simple matter to show how the gain can be utilized either to reduce the size, the weight or the velocity of a machine:

The output of an electrical machine is proportional to the strength of the magnetic field multiplied by the number of wires on the armature, and the velocity of the latter. To make a comparison between machines with a different number of poles, the velocity must be assumed to be the same in all cases. The strength of the field will be proportional to the cross-sectional area; therefore, one pole with a cross-section of 100 square inches will be equal to two poles of 50 square inches each, or four poles of 25 square inches each. The above statement will be true if the magnetic density per square inch is the same in each case, and that is the condition here assumed. The number of turns of wire that must be wound on the magnets to give this density will be proportional to the magnetic resistance of the magnetic circuit.

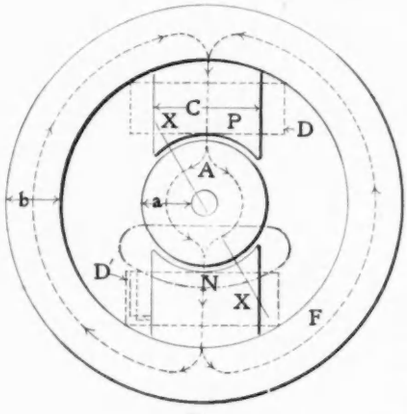

Fig. 1

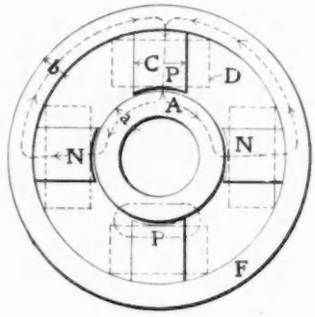

Fig. 2

Fig. 3

Let Figs. 1, 2 and 3 represent three dynamos—one with two, one with four, and one with eight poles. The outside diameter of the armature is the same in the three cases; therefore, the number of turns of wire upon it will be the same. The length of the armature, as well as the width of the field, is assumed to be the same in all cases.

In Fig. 1 the total magnetism of the field passes from the pole P, through the armature, to the pole N, and back through the field ring to P, as shown by the dotted lines.

In Fig. 2, there are two P poles and two N poles; therefore, if half as much magnetism passes through each set, the total amount passing through the armature will be the same as in Fig. 1. But if only half as much passes through each path, the cross section will have to be half as much; that is, C in Fig. 1 will be twice as great as C in Fig. 2. In Fig. 1 it will be noticed that a and b are equal and only half as great as C. This is because C carries all the magnetism, while a and b only carry one-half. For the same reason, in Fig. 2, a and b are one-half as great as C. Therefore, a and b, in Fig. 1, are twice as wide as in Fig. 2.

In Fig. 3 there are four P and four N poles; hence, the amount of magnetism circulating in each set will be one-quarter as much as in Fig. 1, and C, a and b will be one-quarter as wide as in Fig. 1.

A little reflection will show that these three machines will be of equal capacity if magnetized to the same density per square inch, because the effect of the two P poles in Fig. 2, and of the four P poles in Fig. 3, is the same as the one P pole in Fig. 1. As the armatures in each case are the same size and have the same number of turns of wire, the output of the three machines must be equal. But a glance at the three figures will show at once that there is a great difference in the amount of iron, both in the field and the armature, and also a considerable difference in the size of the machines. In order to demonstrate fully that the three machines are of the same capacity, it remains to be proved that the magnetic density per square inch is the same in each case.

(To be concluded next week.)

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Walker's Magnetic Clutch for Drill Presses.

We illustrate herewith a new electric clutch applied to a drill press, invented by Mr. O. S. Walker, of Worcester, Mass., whose magnetic planer chuck was illustrated and described in our issue of July 16th.

The great advantage of the clutch here shown is the promptness of its release, which is practically instantaneous, whereas a loose pulley and shifting belt require about a half turn of the shaft before the motion of the machine actually stops. With the magnetic clutch the release is so prompt that it may be used in tapping holes even to a closely defined depth—an operation which is shown in the illustration.

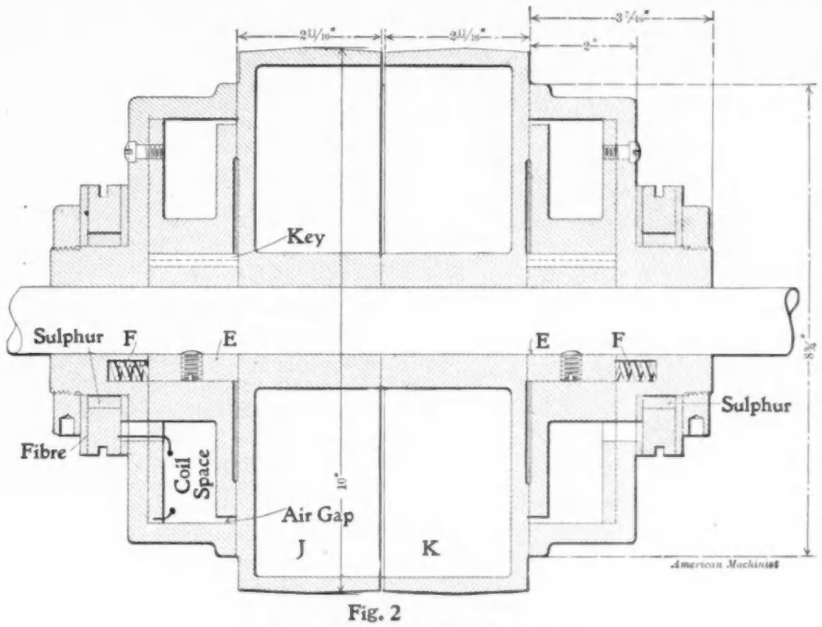

Fig. 2
SECTION OF MAGNETIC CLUTCH.

A drill press fitted with the clutch is shown in Fig. 1, while the construction is shown in Fig. 2, which is from a working drawing. In both cases two clutches are shown arranged for open and crossed belts.

The drill press shown in a 21-inch machine and is used mainly for tapping. *J* and *K* are loose pulleys running in opposite directions by belts from the main line. A push button delivers current to the left-hand clutch, which thereupon seizes the side of the moving pulley *J* and revolves with it, driving the drill forward. Pushing another button switches off the current, when, the magnetism falling, the clutch is detached from all contact with the pulley by the spring *F* impinging on the shoulder collar *E*, fast to the countershaft. To reverse the direction of the drill spindle, the opposite clutch is energized in precisely the same manner as the first one, by means of another push button, the stopping button being common to both circuits. These push buttons are arranged in a vertical row convenient to the operator's left hand, as shown in Fig. 1. Both this clutch and the chuck described in our issue of July 16th have been developed and are in regular use at the works of the Norton Emery Wheel Co. Mr. Walker says of the clutch:

"It is not too much to say that this device has paid for itself many times over in our works during the past year, and there seems to be no reason why engine lathes should not be so equipped in their overhead works, and the whole be operated by push buttons in the apron."

A drill press is a machine which often requires to be stopped without losing any time in doing it, and this device would seem to possess exceptional advantages in that direction.

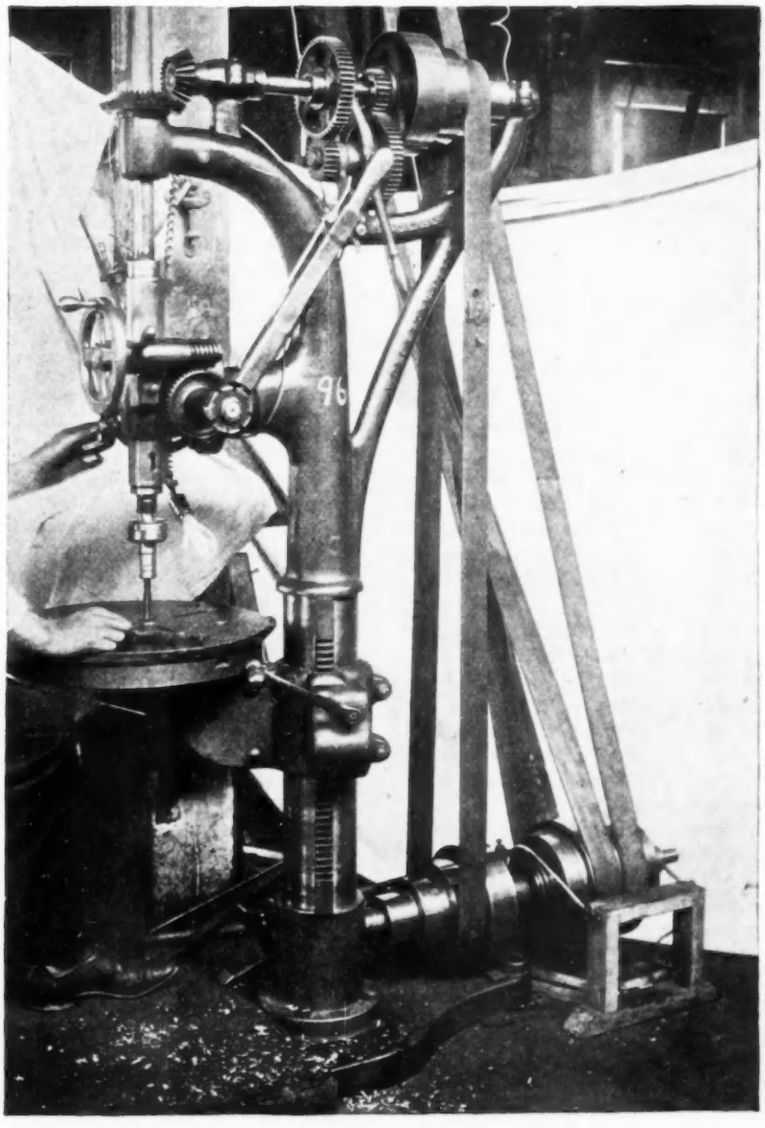

Fig. 1. WALKER'S MAGNETIC CLUTCH.

For three or four years the people of Franklin, Mass., have been wishing for an electric street railway connection with the other towns in Southern and Western Norfolk County, and now a company has been organized and has secured the necessary franchises, and the building will begin either late in the fall or early in the spring. This line will begin at Caryville, running thence through the Medways to West Medway, and from there to this town, and thence eventually to Wrentham, to connect with the Providence system.

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A scheme has been launched for the supply of electrical power to San José, Oakland, and eventually San Francisco, Cal. The current is to be generated by burning waste coal at the Corral Hollow mines. As this waste is a necessary incident to coal-mining, its cost for this purpose is nothing. The scheme is parallel with a similar one for turning the culm banks of Scranton into electricity for use in New York, but the Westerners seem to be ahead of us in carrying it out.

Iron is found to deteriorate in its magnetic properties with long use, in consequence of which its response to the current in the magnetizing coil is less prompt. "Magnetic fatigue" is a term which has been coined to express this change in the iron. Probably no part of electrical machinery design is on so unsatisfactory and empirical a basis as the selection of the iron or steel for its magnetic properties. A rich field of research lies before experimenters in this line of work.

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The new highway swing bridge connecting Middletown with Portland, Conn., is now operated by electric motors. Where current can be had from established circuits this would seem to be an excellent application of electric power—that is, where the bridge is too large to be operated manually by one attendant.

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Letters from Practical Men.

Press Work and Piece Work.

Editor American Machinist:

I would like to hear from some of your readers who handle press work as to how they keep track of the work—I mean the shop end of it; if a man punches a thousand washers, how do they know he has a thousand? Do they take his word for it; do they weigh them up, count them, or use a revolution counter? I have used all of these ways, and, for that matter, am using them all now; but I am not satisfied with them, neither is the press-hand.

Take the weighing up, for instance: I well remember the clerk one day weighing up a lot of work; it was a shop box nearly full of small punchings. After weighing, he asked the press-hand what the box weighed; now, most of the boxes had the weight marked on the end, but this one was an exception. "Dump it out," said the clerk, "and I will weigh it;" but the man objected. "Nonsense," said the weigher, and suiting the action to his words he put the contents of the box into an empty one that stood near, and as the work came out it revealed a broken press shoe, weighing about twenty pounds, in the bottom of the box. A look of disgust came over the face of the man as he said: "Well, that's the only way I could make the job pay, anyway." He was promptly fired for the trick and is now a successful politician.

There is a certain class of work that you must trust, to some extent, to the honesty of the press-hand. At one shop where I had the misfortune to be employed we made a large variety of work in small lots of ten to one hundred each, and one price was made on all kinds; and as it was a good deal of work to keep track of it, I used to trust to the honesty of the press-hand, and I never got left that I know of. Then I got a lot of counters, or "indicators," as the boys used to call them, and stuck one on every press. The cost was pretty high (about $10 each) and I had fifty presses, but they worked well—too well, in fact, I thought one day when I caught one of the boys on the night shift with his foot on the treadle, running the press for all he was worth with no work on the dies. He was sent to join the comrade of political fame, and I had no more trouble upon that score for a while.

We have been running this way now about a year, and shall continue to do so until I find a better one. The clerk goes around every morning and puts a punched slip on each press, with the number and where the index now stands; and as a job is finished, the die setter puts over it the figures as it then stands, and the difference indicates the number of strokes made. Of course, in some classes of work, as punching washers out of scrap and using a gang die, we do not get a washer for every stroke of the press; but as this is well understood in the office and the price is based accordingly, no injustice is done.

I should like to hear from some of your readers on this subject, for if there is a better way I want it.

A. P. Press.

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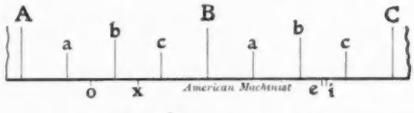
Micrometer Readings.

Editor American Machinist:

In regard to Mr. Swift's communication in issue of July 16th, I will say that balls cannot be sorted into boxes with $\frac{1}{8000}$-inch extreme diameter variations without the use of boxes to hold them. Mr. Swift assumes that there are only boxes enough



in use on the Lozier ball-sorting bench to hold the $\frac{1}{4000}$-inch variations, Such is not the case; there are plenty of boxes at the Lozier shops.

If balls are measured to the "nearest" $\frac{1}{4000}$-inch graduation on the micrometer wheel, then the error in reading is certainly inside of $\frac{1}{8000}$ inch. In Mr. Swift's assumed dilemma there is no "nearest"; therefore this dilemma is not within my wording of June 25th.

Referring to Mr. Swift's engraving which is here reproduced, and which is a plane development of the surface of the graduated micrometer wheel, supposing *A* to lead in making a measurement which finds its contact when the index mark is at "o," midway between "a" and "b" which are $\frac{1}{4000}$ inch of screw-point travel apart: then the intelligent girl who handles the micrometer knows that the diameter is less than the "a" reading, and greater than the "b" reading, and she therefore puts the ball in the box intermediate between the "a" and "b" even $\frac{1}{4000}$-inch sizes.

In case the contact comes with the index mark midway between "b" and "c," the intelligent girl has every possible evidence of her own eyes that the diameter is $\frac{1}{4000}$ inch smaller than in the previous case, and, though I will not deny that Mr. Swift might find excuses for putting the second ball in the same box with first one, the girls at Lozier's would not make such an obvious error.

Hugh Dolnar.

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Holding Piston Rods.

Editor American Machinist:

The late lamented Shah is said to have had valuable tips as to the results to be expected in all Oriental races in which the royal stables were represented, and also to have had numerous opportunities to devote his spare moments to more congenial pastimes. He was also a man of great erudition, and early learned the uselessness of attempting to have the last word in regard to any proposed innovations in the management of the royal harem. Profiting by the sage knowledge of this distinguished arbiter, so felicitously introduced into the piston rod discussion by friend Swift, I shall refrain from further following this much disputed subject. The time and expense were cheerfully given, and I am glad to welcome so able a critic as Mr. Swift to the ranks of those who think jam nuts on piston rods "objectionable," even if he thinks the way I propose far worse.

I hope none of our readers will think it necessary to put a greater strain on any lock nut they may have than the maximum load is to be. It sort of strains things.

P. H. Bullock.

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Shade Lines—Placing Lathes.

Editor American Machinist:

About the shade lines, I merely wanted to know, you know. People will sometimes ask a question just for the sake of starting a conversation, and sometimes they get into very unpleasant predicaments by it. It seems that shade lines are too sacred to be touched by sacrilegious hands, too dear to the heart of every draftsman to be even spoken of except with loving sympathy. The draftsman's sun, so far from being a portable one, does not even rise or set, but evermore shines over his left shoulder at an angle of 45 degrees to everything, and nothing can extinguish it or knock it out of position. Well, if the rest of the mechanical community refuse to cut off their noses at my suggestion, I do not propose to run around without my own. Better be out of the world than out of fashion; so that settles that.

The "Easy Way" of arguing these things is not to my liking, and, like some other easy ways, is not the best way. Once upon a time, "it is said," an expert took a common sewing needle 1⅝ inches long and drilled a hole through it from eye to point; and now, to prove that I am all

wrong on my shade lines, "Easy Way" says that any watchmaker can drill a needle like that. I don't believe "Easy Way" could even make a full-sized drawing of the needle with the shade lines correct on it, and I still less believe in his ability to produce from any source the finished needle.

The question recently asked about placing lathes in a shop is an interesting one, and one that at different times has had considerable discussion, and is still deserving of much more. It is a question that cannot be discussed independently, because it depends so much upon the design and location of the building, and especially the lighting of it. I can speak of the general arrangement of one shop that was built forty-four years ago (I did not witness the building of it) and which would be considered quite respectable even at the present day.

The building I speak of was 300 feet long, north and south, 50 feet wide, and two stories high. The floor of the second story was supported entirely by the trusses of the roof, the wall being carried up of double thickness under each truss, and large windows being placed between the piers thus formed. The office and drawing room occupied about twenty-five feet of one end, a brick wall all the way up separating it from the shop, with several windows looking into the shop. For perhaps fifty feet from the office the second floor was left out and the upper story was left open, so that either story could be seen from the office. The open space next the office was used as an erecting floor, some of the engines or other machines set up there being quite high. Two swinging cranes commanded nearly the whole floor. This was before the day of the power hoist or the traveling crane.

The floor of the entire building was nailed to timbers bedded in the gravel. The shop was upon an island in the middle of a river. The floors used to rot away fast, and the men acquired an unpleasant habit of dying of consumption. The first story was 12 feet clear, and the line shaft ran down through the middle, being driven from near the middle of its length by a belt from the engine in a building outside. The line shaft was large, ran rather slow, and was in comparative short lengths, with one hanger to each length and a flange coupling close to each hanger. The couplings were made to each form a pulley about 24 inches diameter and 12 inches face. The other pulleys used on the line had solid hubs; and when at any time a new machine was put in, it was customary to have an all-night job of taking down a length of shaft, getting a coupling off, putting the pulley on, and then getting things back as they were. Later, it was discovered that split pulleys could be used. Of the tools in the shop, the lathes were, of course, the most numerous, these being placed back-to-back down through the shop as far as necessary. An open space, say 15 feet wide, extended the entire length of the shop, with a track in the middle upon which cars could be run in with material from the foundry or the blacksmith shops. A heavy car with a swinging jib crane was also run upon this track, and commanded the inner row of lathes, which were the largest, and a few other tools. This crane was a great convenience. It would not only hoist and lower for the tools that it commanded, but would pick up things too heavy to handle and carry them from one tool to another, or wherever they might be wanted.

The shaper, slotter, planers and drills were placed where most convenient, but all so that the open space through the center of the shop was preserved, and another open space at each side between the lathes and the benches that extended down both sides of the shop against the walls. There were many more vise men employed in those days than would be required now, and more benches were wanted.

The lathes were all tolerably well lighted. The outer row, of course, had the light behind the workman. The location of the lathe endwise made quite a difference with the light on this row, and where the nearest window came a little in front of the face plate the light was better than where it came a little behind. The inner row of lathes had a more diffused light, and little inconvenience was experienced. After some years of increasing dinginess the walls and ceiling were whitened, and this made a great difference in the light, and if the whitening could have been repeated at least once a year it would have been a good investment. The lighting of tools by side windows, no matter how the tools may be placed, is not as good as overhead lighting, although for bench work the side light is sometimes almost indispensable, as the workman often wants to be able to sight across his work. In the shop I speak of I had many other lessons on shop design and tool arrangement, but cannot well speak of them now.

TECUMSEH SWIFT.

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Wants a Better Engineers' Pocket Book.

Editor American Machinist:

I have something on my mind, and I have had it there a good while, and I have got to talk to somebody about it, and I believe that the "American Machinist" is the precise place to do the talking, if I may be allowed to. Everybody knows what an Engineers' Pocket Book is. I believe it is a tool of the greatest importance, and it certainly is in almost universal use. I believe it is almost comparable with the grindstone, at least by its presence in every establishment, if not by its frequency of employment in it. Now, I know that the "American Machinist" is in duty bound to herald all the improvements in lathes and planers and drills and all the various tools of the shop, to criticize, commend or suggest as occasion may arise; and all that work seems to be attended to all right; but is it not equally bound to speak of those other tools, such as the pocket book that I am speaking of? It certainly is a labor-saving tool and a necessary tool in these days. A handy compendium of tables, formulae, rules and general data that cannot be carried in the head, but which must always be quickly available for use, is a necessity with everyone who has the least thinking or planning to do in mechanical lines. No other tool that I can think of can have so wide a range of employment as this. Some, of course, must use it much more than others, but the number that will use it more or less is a vast one. The extensive sale and the universal presence of the pocket book, in some form, in shop, in office and in drawing room, attest its great importance; and that its importance is constantly increasing must be self-evident. The stock of knowledge that we have to carry and to use, however we may continually condense and compress it, is a constantly increasing one, and the possibility of doing our work without having it ready at hand continually diminishes. We simply must carry our supplies with us, or suffer defeat on many a field.

Now, I am not in the least disposed to under-estimate the task of preparing this collection of readily available knowledge. I am well aware of the great ability, the industry and the conscientious sense of responsibility which have been devoted to this class of work; and yet I have to say with regret—this is only my own private opinion—that a satisfactory work of the kind that I am speaking of does not exist for the use of the mechanical engineer, or even the mechanic of the shops. There is still much to be desired, and, moreover, as I think, much that it is still possible to accomplish, in the way of a handy, reliable, comprehensive and nearly up-to-date mechanics' reference book, for the use of machinists, mechanics in general and the mechanical engineering profession.

Many men have devoted their lives to the production of works of far less value than such a one as this would be, and I, indeed, do not expect to see a work approaching the ideal, except it be the life work of a peculiarly constituted and qualified individual. The nearest approach to this ideal is, to my thinking, Trautwine's "Engineers' Pocket Book," and if it was, as it distinctly disclaims being, and as it is not, a mechanical engineers' pocket book, and equally thorough, comprehensive and reliable upon all mechanical topics as it is upon the lines to which it is specially devoted, I would not probably be moved to my present line of remarks.

My idea about the pocket book that is

wanted is, first of all, that nobody should try to get it all into one big book. There is quite a temptation to the bookmaker to do this, and it is all wrong. At the very beginning it defeats one of the most important features that the work should possess. The book is unhandy. There are a great many things that are in all the pocket books, that are common property, and that everybody wants continually, such as tables of weights and measures, of squares, cubes and roots, of areas and circumferences of circles, etc. These should be collected into one little book that would be both cheap and handy, and these should never be used in any more bulky form. Lots of pocket books, even the most pretentious and costly, are worn out prematurely and thrown away on account of a constant reference to perhaps one-tenth of their contents. The same tables inserted as padding in the treatises upon special subjects that appear from time to time, are even more absurdly misplaced.

Even the standard matter might be conveniently divided into at least two handy little books. The first, that I have just spoken of, would consist principally of figures for use in the various computations that have to be made. A second little book would also consist largely of figures for use in computation, but in combination with various information as to the physical properties of matter and the actions of the various forces that we have to deal with. In this would come strength of materials, specific gravities, properties of steam, etc. All this work has been very well done except that the matter has not been gathered into the small and handy volumes that I would like to see in use, but it has been buried in more bulky and pretentious volumes, to the mutual inconvenience of everything and everybody.

The real work of the maker of the reliable reference book begins after all this has been disposed of. He has to collect all available information upon every subject that mechanics or engineers have to do with, to sift and condense it and arrange and index it, so that it may be readily found by those who seek. I really think that the collecting of the matter, and even the arrangement of it, is by no means as difficult as the sifting that must be done to give the matter its proper weight and value. It will not do to tell us what A says, what B says and what C says, or what they have each done, if the data they give is widely at variance and irreconcilable. The seeker for information wants to know more than anything else what to accept, and it is a tantalizing mockery to offer him data when he has no means of knowing how much of it he may rely upon and safely act upon. The maker of the book must therefore have a wide general knowledge, a trained judgment and a decision of character that will enable him to speak authoritatively upon every subject. This is asking a great deal, if it is not asking too much, and it contains the suggestion that the book should still be subdivided into different groups of subjects, with separate compilers for each, who shall presumably have special knowledge upon the separate class of topics assigned to each. Above everything else, the book or books must never be considered complete or finished, but must grow, partly by excision, with each edition. I hope to see something of this kind before I die, if I live long enough.

MORRIS FULTON.

Philadelphia.

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The Molding Machine.

Editor American Machinist:

There are a great many small castings made with the rammers and with a single pattern that can be made better, quicker, cheaper and nearer true to pattern with a machine than they can be made by hand. The writer was formerly foreman of a foundry that made, among other work, floor and ceiling plates from ½-inch to 6 inches, molding them with a machine. A good stout boy was the molder. He had had no experience whatever, but in four days he was able to put up eighty-five molds and in six days one hundred molds. The castings would not vary six ounces in one hundred pounds, and they were taken from the tumbling barrel and sent to the shipping room without expending any labor on them.

The patterns for use on a molding machine must be perfect—so nearly so that when drawn from the mold there will be no tool work to be done. The follow boards can be made so that there will be no adjusting to do on the machine to make any size floor or ceiling plate from ½ inch to 6 inches. The molding machine must be set on a good level, solid foundation and bolted firmly. There are several molding machines that do good work, any of which will do more and better work that a first-class molder; but there is quite a difference in machines. Some get to pressing one-sided—first on one side, then the other—and some need repairing often, it being necessary with some to take them down and send them to the machine room for that purpose. A good molding machine will do at least forty per cent. more work than a molder can do by hand, with no makeage on the castings, which on small work, with a careless molder, amounts to ten per cent. extra weight. Small foundries with plenty of floor room could cover the floors quickly by the use of one machine, by having foundations for the machine on both sides of the shop. The machine could be removed in fifteen minutes if the bolts in the foundation block are set in before putting in floor. After the molding machine is placed, have one man tend to all repairs and make all follow boards to conform to the machine on its longest stroke.

There is much objection to machines from some molders who fear to lose their jobs by their introduction. In one foundry that I know of, a machine was put in twenty years ago, and the men purposely spoiled all the work they made for two or three days, so that the machine was condemned; but to-day it would be hard to find more than one pair of bench rammers in that shop, and they do some fine work, while the men do more work for the company, earn their wages more easily and earn more money.

HARD IRON.

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Uses and Advantages of a Public Supply of Compressed Air.

BY FRANK RICHARDS.

Driving Water Motors.

Our consideration of the various modes of applying our compressed air to the raising or forcing of water, and particularly our determination of the cost of such service in my last paper, opens the way quite naturally for us to see some of the uses to which the water might be put which would not be possible, or at least practicable, without the air pressure, and one of these uses would be the running of water motors for domestic or light manufacturing purposes, for operating fans in the summer, and for similar work everywhere.

It would seem at first sight that it must be a wasteful and costly arrangement to use our compressed air first to raise or force water against a pressure, and then to develop our power by employing this water in a water motor, instead of using the air directly in an air motor, and no doubt this would be true if we had but this one use for the water; but if we must have the water pressure anyhow for general purposes, then its additional use for driving water motors might be in many cases the cheapest and simplest possible arrangement.

It happens that the jet water wheel is an extremely simple apparatus, and also one that is reasonably economical in the development of power. Within a few years the Pelton wheel has shown results which for efficiency have astonished the engineering world. This wheel, as almost everybody knows, is a simple wheel of relatively large diameter, usually with a horizontal axis and with a series of small buckets upon its periphery, and a jet of water of small diameter and high velocity impinges upon or into the buckets. Tests of this wheel have shown efficiencies as high as 87 per cent., and 80 per cent. is quite common. This wheel is no novelty, at least in principle, but is indeed one of the oldest types of wheels, and has been known and used in different countries and for many years. A correspondent in the columns of the "American Machinist," a year ago, described a wheel of this type, but on a vertical spindle, which had been in use in Spain far beyond the memory

of the oldest inhabitant. Miniature wheels of this type have been in use all over the United States for twenty years, for driving sewing machines and such light work. In one city, much devoted to the collar and cuff industry, these motors are found in use in many houses, and although the water supply of the city is mostly furnished by steam-actuated pumps, the annual charge for water for one of these wheels is only $5. I do not believe that the water board of the city realizes any profit from this line of service, where the machines are run very constantly; but it is not done with any money-making intention upon their part.

The wheel spoken of above for driving sewing machines gives good satisfaction, and is far beyond the days of trial as to its desirability for this special purpose. It is furnished complete by the makers for $15, not including the piping. This wheel will run a sewing machine perfectly on 20 pounds of water pressure, although a higher pressure is desirable rather than otherwise, and it will use from 30 to 50 gallons of water per hour. We will take the higher figure. In my last paper, June 18th, it appeared that the air cost of the water, if used at 100 pounds pressure, would be 6¼ cents per thousand gallons. If used at 50 pounds pressure, equivalent to a head of 115 feet, the air cost of the water would be considerably under 5 cents per thousand gallons; but as 5 cents is a convenient figure to handle, we may as well accept it. If the sewing machine required 50 gallons per hour it would require 500 gallons, or a half thousand, per day of ten hours if run constantly, and it would consequently cost 2½ cents per day, or $7.50 for a year of 300 working days. The cost would be exactly in proportion to the work done, and if the motor did not run all the time there would be absolutely no cost for the times when it was idle. The jet water motor seems to be well adapted to the running of isolated sewing machines and many other similar purposes. One great advantage is that the operator has perfect and instantaneous control of the speed and power, which cannot be said of some other styles of small motors, and, indeed, of most of them quite the contrary is true.

As to my style of computing the costs and efficiencies of the apparatus about which I speak, there are those who would condemn it as crude and perhaps unsatisfactory and unreliable. Now, I personally have considerable confidence in this rough-and-ready style of computation for getting approximate estimates, which, at the best, are all that is possible in such a case as this. Rough tools are for coarse material. When we get accurate, sharply defined data, then it may be proper to go planing off our thin decimal shavings; but until we have such data our deductions from them should not be too finely drawn. Our figures about the cost of running sewing machines by jet water motors will give a good idea of the cost of many other light power applications of our water (with air behind it) that would be equally practicable.

With the use of the air pressure upon the water, the possibility of using the water over and over again comes in. It is undoubtedly true that the small water motor would be much more extensively used were it not for the actual value of the water itself, independently of the pressure that it carries, although the pressure and not the water is the available fact when the question of power is considered. In many cities or in most cities the small water motor is impossible on account of the scarcity of water. But if we can avail ourselves of the pressure without decreasing the stock of water, the case at once assumes a different aspect. With our two tanks and the automatic air pressure apparatus for forcing the water, as spoken of in our last paper, the water that has been used in the motor can be as well used as fresh water from the main for refilling the tank previous to applying the pressure; then, when the tank is filled and the air pressure is applied to it, the contents are all ready to flow to the motor, and it ceases to be true that "The mill can never grind with the water that has passed."

The water that has passed is just as good for all purposes as the water that has not passed, when it has the air pressure to stand at its back. The water, though passing through the motor several times, cannot be contaminated or polluted by its passage any more than by passing through a corresponding length of pipe, as no foreign substance can be taken up by it, not even a trace of any lubricant, as the water itself is the only lubricant within the wheel chamber.

This water motor service has been spoken of here, as it seemed to come in naturally as the consequence of what has immediately preceded it. I do not expect to see many water motors used under the conditions that I have spoken of. I expect the compressed air will generally get at its work more directly; still there are places where the jet water motor could be used to advantage, even with the air as the ultimate driver, and it may be well to bear it in mind.

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In the list of patents issued July 14th we notice two for a valve device for compound locomotives, to E. F. C. Davis, late president of the A. S. M. E., who was accidentally killed in Central Park last summer. The patents are assigned to the Richmond Locomotive Works.

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The largest commercial undertaking on earth is the London & Northwestern Railway. Its capital stock is 120 millions sterling. Its shares are worth 200, and its dividends throughout its fifty years of life have averaged over six per cent.

Some Experiments With Car Wheels.

It is known that chilled cast-iron wheels, commonly used for freight cars, are liable to be cracked from the heating of the tread when a long-continued application of the brake occurs, and several accidents having occurred on heavy grades owing to wheel failures, an experiment was suggested. The wheels to be tested were placed horizontally in a mold of sand with an open space of a half an inch or so around the rim. Then molten metal was poured into this space, heating the rim quite suddenly, and of three wheels tried one cracked in 40 seconds, a second one in two minutes, while the third wheel showed no signs of failure. The latter wheel was made at the Altoona shops, and that it stood this test would seem to guarantee it absolutely from ever giving out on account of heating by brake friction.

As to the conditions secured in this experiment, they must be considered to have been not a reproduction of the conditions to be investigated, but an exaggeration of one of them. The heating by contact of molten metal was more sudden than the heating by brake friction could be, and in that respect the exaggeration may have been preferable rather than otherwise; while the other conditions which have to do with the braking of car wheels in use, the severe and changing pressures and the sudden shocks, were entirely absent. Experiments such as these, of course, have their value and are to be encouraged, but they should not be taken to prove too much.

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A Free Employment Bureau has been opened at 331 East Fourteenth street, New York. It is under the direction of the Bureau of Statistics of Labor, and is managed by John J. Bealin. Anyone wishing employment can apply at this bureau, and upon filling out a blank will have his application filed, and will be assisted to a place, free of charge. Several hundred applications were filed the first day, and about one hundred persons stood in line before the office opened, waiting to make application.

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It is announced that the Cunard Steamship Company have ordered the construction of three 5,000-ton steamships. Their capacity will therefore be less than one-half that of the "Campania" and "Lucania." They are to be built at Belfast, and will be used for freight and the cheaper class of passenger traffic.

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We learn from a British source that a patent has been taken out in America for a nickel-in-the-slot attachment for hired bicycles. Unless the machine is fed a nickel at measured intervals, an automatic brake locks the wheel, and it refuses to turn until its appetite is appeased.

American Machinist.

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Tool Steel in Machine Construction.

A curious variation in practice with regard to selection of material is to be found in bicycle factories. If one buys a wheel made anywhere in New England, the cups and cones are pretty sure to be made of mild steel, case-hardened; while if he buys a high-grade wheel made west of the Alleghanies, these parts will more likely be of tool steel hardened in oil. In this matter the Eastern makers have simply followed the practice of the leading concern of that section, which has tried tool steel for this purpose, had poor success with it and given it up; the general conclusion from their experience being, not merely that for the conditions of working and use under which the trials were made the particular steels tried were not suitable, but that tool steel is not fit for cups and cones. It may seem curious that practice should thus divide on geographical lines, and there seems no other way for accounting for the fact than that one section has been influenced by a precedent which has been disregarded or ignored in the other.

A somewhat analogous state of affairs is found in the use of steel in locomotive construction. There are roads that will use nothing but steel for crank pins, and there are others that will use no steel for that purpose and will have nothing but iron. The reasons on both sides seem to be founded upon experience. Those master mechanics who use iron can show you lots of broken steel crank pins as a basis for their belief in the utter unfitness of the material for that purpose; while others can show you hundreds of steel crank pins in use, in equally severe service, and with less breakages than they had when using iron.

Mr. Wm. Metcalf has placed on record a somewhat curious experience with steel, in which a high carbon steel piston rod was put into a steam hammer because the mild steel rod had broken, as numerous similar rods had done before, and this time there was no mild steel bar at hand. It was not expected that the tool-steel rod would stand the work at all, at least not nearly so well as the mild steel ones; but it stood much better, and led to the adoption of tool steel for that purpose in that establishment.

No one is to be blamed for following the path indicated by his own experience, and it is natural that one should follow one's own experience rather than that of others; but in this matter of steel, it is well not to be too confident that general conclusions can be drawn from individual experience, especially when that individual experience fails to do more than cover one small corner of the field.

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The Bicycle Industry as a Blight.

The manufacture and use of bicycles are causing some curious effects on our manner of living, and also some curious ideas on the economic effects produced by the new industry.

An American contributes to a London paper a letter in which he savagely attacks the wheel and virtually charges it with all our present difficulties—economic, political, commercial, social and spiritual. He says that "millions and millions of dollars are being withdrawn from the normal course of trade and diverted into this one branch, and other people find it extremely difficult to get money to live on."

The wonder is how anyone can imagine any better agency for the general distribution of money than such an industry as bicycle-making. Such people as this writer imagine that all the money paid for bicycles is simply put into old woolen socks by the manufacturers, and that none of it goes into other channels of trade through the medium of bicycle factory employés and the employés of other contributory industries. We think the fact is that the strong desire for wheels has made the general business condition much better for the past few years than it would have been without it, and that very much more money has been kept in general circulation than there would have been had no such strong incentive to spending money been exerting its influence.

Those people who are always declaiming against the paralyzing effect of the bicycle industry upon other lines of trade, forget about the many thousands of men who have had and now have employment in bicycle industries, and who, were it not for this industry, might have had nothing whatever to do and much less money to spend in lines of trade where it is thought the "bicycle craze" is ruining them. The lamented millions that have been spent for bicycles have not been destroyed, nor have they disappeared, and it is altogether probable that as much of the money is to-day in general circulation as would have been had it been spent in any other way.

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The facility with which manufacturers will get into ruts, and the persistence with which they will stay in them, are illustrated by the experience of a friend of ours who recently became superintendent of an establishment in which a small machine had been manufactured for a good many years, but without modern or proper tools. In revising the methods of manufacturing this machine, he reduced the number of varieties of machine screws used in assembling it, for the purpose of economy, and found they were using several sizes of special screws which could not be purchased in the market, but had to be made by manufacturers on special orders. One day a requisition for some of these screws passed through a friend's hands, and he inquired why those special sizes were used. The reply was that they were ordered to suit the taps, the size of which taps had been adopted at the start, and that screws of corresponding size must now be used, or else the taps in stock would be useless. Our friend showed by a very few figures that the difference in the cost of this one order of special screws and the same number of regular screws would be sufficient to more than pay the cost of a complete outfit of new taps, and it did not take long to reduce the screw list to standard sizes throughout.

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Years ago egg-beaters were made to revolve rapidly by making the shanks of wire, twisted in spirals, and placing over these shanks a wooden thimble with a projecting pin to engage with the spirally-twisted wires; thus, moving the wooden spool vertically revolved the wires and accomplished the object of the invention "as set forth." The same principle was afterward applied to small drilling devices, and is still used for that purpose. Now comes a Chicago inventor who has employed this principle by grooving his shafts and arranging to engage the spiral grooves with balls instead of pins, by which, we suppose, he avoids most of the sliding friction, and the improvement may be useful. He claims, however, or at least a Chicago paper claims for him,

that the invention is of the utmost importance, and will entirely change the form of marine and other engines. In fact, it is announced as another of the very many inventions that have been brought out that are going to supersede the crank as soon as obtuse mechanics can be made to see their advantages.

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The "Scientific American," of New York, has signalized its fiftieth anniversary by the publication of a very handsome 72-page special number, which consists of a review of the development of science and the industrial arts in the United States during the past fifty years.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(137). N. H., Worcester, Mass., refers to figures giving the efficiency of a Willans engine driving a direct-coupled Siemens dynamo, which are given on page 175 of Professor Crocker's "Electric Lighting," and asks how $\frac{E\ H\ P}{I\ H\ P}$ can give any clue to the efficiency of the engine as a heat motor. A.—Had you turned the leaf you would have found at the top of the next page that the efficiency given "allows for the losses in both the dynamo and engine;" that is, the efficiency found is between the indicated horse-power absorbed by the engine and the electrical horse-power given out by the dynamo. The heat efficiency is not touched upon, but simply the combined mechanical and electrical efficiency of the engine and dynamo together.

(138). F. W. Q., Newport News, writes: Please answer me the following, through your paper, at your earliest issue: 1. What would be the melting point of an alloy of 25 parts of zinc and 5 parts of copper? A.—We do not know. 2. Which is the better heat radiator, glass and porcelain or any of the metals? Tyndall, in his book "Heat a Mode of Motion," says glass, porcelain, lampblack, varnish, etc., are good radiators. Please tell me which is best? A.—Calling the radiation of a surface covered by lampblack.....100
Then glass equals.....90
Cast iron, polished equals.....25
Wrought iron, polished equals.....23
Steel, polished equals.....17
Brass, polished equals..... 7
Hammered copper equals..... 7
Varnish, polished equals.....14
Silver, polished equals..... 3
Calling rough cast iron.....100
Then planed cast iron equals.....32
Draw-filed cast iron equals.....20
Polished cast iron equals.....18

(139). J. P. D., Leavenworth, Kan., writes: I wish to discharge a large number of jets of compressed air through ⅛-inch pipes, at a pressure of about four atmospheres. Would it be best to use a non-compound compressor, or a two-stage compressor, and run the air to the pipes through a reducing valve; that is, would not the latter use less steam for compressing? A.—The higher the pressure to which any given volume of air is compressed, the greater will be the power required to compress it. The saving of power effected by two-stage compression, with efficient cooling of the air between the stages, is not available in compressing air to only four atmospheres. We would use a single-stage compressor with a well-jacketed cylinder. If the air was to be carried a long distance, the saving in pipes might warrant the carrying a higher pressure and the use of a two-stage compressor, as suggested; otherwise the single compression would be simplest, cheapest and best.

(140). J. W. C., Evansville, Ind., writes: Can you tell me anything about the use of a steel triangle in place of a gong for signaling or calling? How is it made, how is it used, and how good is it? A.—There is, of course, no novelty about the triangle. As a developer of clear and penetrating sound it is not to be despised. The fact that it must be suspended freely and cannot be held in a fixed position, so that a mechanically operated striker can be used, has prevented its more general adoption. The Arthur Company, Front street, New York, have a triangle in their shops located near the office door and used for calling some of the floor-men, wherever they may happen to be. The sound of the triangle is there considered much preferable to that of a gong, being easily heard in every portion of the four-story building. The triangle spoken of is not large. It is made of ⅞-inch steel, the sides of the triangle being each about 21 inches. It is suspended by a ¼-inch round leather strip, probably a piece of round leather belting, and it is struck near the middle of the side opposite the opening by a small hammer that is kept near it on the bench. The angles of the triangle are not sharp, the ends of the steel at the opening curl outward a little, and in the curve taper to a sharp edge crosswise of the steel. The steel is not tempered. Triangles have proved very effective in some cases for fire alarms and fog signals. Aluminum seems to have peculiar sonorous properties, and probably triangles made of this material, with a little alloy for hardening, would be much superior to those of steel.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Works removed to Boston—See p. 26.

1896 Catalog just out. Boston Gear Works.

Forming Lathes, Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Honest Mach. Oils. F. S. Pease Oil Co., Buffalo, N. Y.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery Name Plates. Twining Campbell, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Form'g and reliev'g lathes for back'g off formed cutters; gear cutters for cutting 2 teeth at a time, any pitch, 2 to 48. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

For Sale or Rent—Foundry and Machine Shop with additional land; in good condition and well equipped for medium heavy work. Capacity of foundry, seven tons per day. Located on railroad within eight miles of New York. Terms easy. Call or address, Room 41, 22 William st., N. Y.

A Circus-Ring Air Compressor.

"The elephant now goes round and round,
The band begins to play."

We are reminded of the familiar poetic gem above by what we find in the columns of our esteemed contemporary, "The Iron Age" of last week. It illustrates with inset and numerous engravings an air compressor, which, if novelty were the only desirable feature in such a machine, would certainly be highly successful; but alas! other qualities must be found in a really successful working machine to compress air. The machine we refer to is the Chaquette air compressor (so-called). It is an air compressor only in name, for we have no hesitation in saying that the complete machine as it stands, and at the rated power of the engines, will not compress air even to five pounds gage pressure, much less the one hundred pounds it is designed to deliver.

We have, of course, been aware of the progress of the construction of this monstrosity, but have felt that our duty to our readers would not warrant us in giving aid and comfort to it in any way. One of the two steam engines to be employed to give the mechanism its first shove was illustrated and described in our issue of March 26th of this year. The engines are excellent, and much more good machine work is to be found in the plant, while some of it is not so good. The engines, by the way, are not compound, as stated in the description referred to above.

To go into the details of this thing a little, we may say that the air-compressing portion of this "air compressor" consists of 100 separate and complete vertical compound compressors with cylinders 16 and 12 inches diameter, and a common stroke of 12 inches. The rest of the contrivance is designed to operate all these compressors at 100 strokes per minute, so that there will be in all 10,000 strokes per minute. The capacity of the first cylinder of each compressor, of course, determines the volume of free air that will be taken in and compressed; and for computing the power required, the compression may be assumed to be all done in the first cylinder, just as, inversely, the work of compound steam engines is often assumed to be done in the last cylinder. The mean effective pressure or resistance in compressing and delivering air at 100 pounds gage pressure, ranges from 30.07 pounds for isothermal compression to 41.6 for adiabatic compression, usually crowding closely to the latter figure; and as these so-called "compound" compressors embody the very prevalent humbug of two-stage compression without efficient intercooling, we may assume in this case a mean effective resistance for the whole stroke of 40 pounds. Then, not to give the computation in detail, the power required to operate these compressors, at the speed and pressure given, will be 2,437 horse-power. The fact that approximately this power will be re-

quired to do this amount of compression no sane man will attempt to deny, and it it very difficult to see how any sane man could assume that two 70 horse-power engines, as provided in this case, could do it.

To get an idea of the arrangement of this compressor, it will be well to imagine a circus ring, only much larger in diameter. From the engines in the center of the circus ring the power is transmitted by gearing to a large horizontal wheel, like a merry-go-round, 82 feet diameter. At the periphery of this wheel are ten groups of three wheels each, the wheels alone weighing about 135 tons. The axes of the wheels are radial. The middle wheel of the three rolls on a raised circular path, one of the other wheels hanging over the outside of the ring, and the other hanging over the inside. As the big wheel goes around, these overhanging wheels come in contact with levers, and, as they roll over them, depress first one end of the lever and then the other, and by that means the air-compressing cylinders are operated.

The assumption of the inventor seems to be that, by this contrivance, the power required to operate the compressing cylinders is in some way dodged or evaded, and that the power required merely to revolve the big wheel and all the little ones, the latter being 9 feet diameter and weighing 4½ tons each, is all that is required. The wheels have only just to roll over the levers, you know. Of course, if the two 70 horse-power steam engines will drive all this, the later assumption, that after the compressor is in full operation air from the receiver may be substituted for the steam, is fully warranted, and there will still be a large surplus of compressed air to be distributed for other purposes, or the machine will be, in fact, perpetual motion with power to let.

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French Tests of Steel for Marine Engine Construction.

At the French Government Engine Works at Indret the steel used is classified under three heads—namely, (1) semi-hard (32 to 35 tons tensile strength with 20 per cent. elongation) in the forms of hammered blooms and hexagonal bars; (2) castings to pattern; and (3) soft (25 to 29 tons tensile with 23 per cent. elongation), and extra soft (21.6 to 25.4 tons tensile with 25 per cent. elongation), also in blooms and bars. The tensile tests are made with the Thomasset testing machine, in which the stress is continuously indicated by a mercury column, while the changes in the test piece are recorded graphically by a registering apparatus designed by Messrs. Richard Brothers, the latter addition being especially useful in fixing the elastic limit—a factor which, for constructive purposes, is of greater value than the ultimate strength.

The toughness, or resistance to fracture by impact, is in the harder qualities tested by the falling-weight method, on what is known as the Ruelle machine, where the test-piece—200 millimetres (7.87″) long and 30 millimetres (1.18″) square—laid upon knife-edges 160 millimetres (6.9″) apart and projecting 50 millimetres (1.97″) from the anvil, is subjected to the blow of a falling weight of 18 kilos (39.7 lbs.), with a rounded end striking midway between the points of support. The minimum weight of the anvil is 350 kilos (771.6 lbs.), the height of fall and other conditions varying with the class of material. For blooms the whole number, and for bars one-half, of the test-pieces must not break before the fifteenth blow, when the fall is 2.75 metres (9′ 0″); while for unforged castings with test-pieces of the same size the initial fall is 1 metre (39.37″), which is increased progressively by increments of 5 centimetres (1.97″) to a maximum of 1.5 metre (59″), the half limit of resistance being applied as in the case of bars. Soft steel is tested for toughness by the forge test of doubling under the hammer when water-hardened. The author considers these tests, especially the last, to be essentially unsatisfactory, as so much depends upon the degree of heat employed. If the metal is too cold the hardening effect of the water is nil; while if the proper heat (about 900°) is used, the structure is so much changed that the test may be satisfied even by steel originally of bad quality. He therefore proposes to modify the falling-weight test, that it may serve both for breaking and bending uses. In this method the test-piece—20 millimetres (0.787″) square—is clamped in a holder with an overhanging length of 100 millimetres (3.937″), which receives the blow of the tup on its outer end. The bar is nicked on all four sides in the plane of the outer face of the holder, and when so weakened it can be broken by a single blow of the weight falling from a height varying with the quality of the metal, and which is called the height of rupture. If, however, the section is not weakened by grooving, the overhanging part is merely bent by the blow, and the angle of deflection produced is taken as a measure of the rigidity of the metal. This angle may be from 140° to 160°.

It is considered that steel in the "natural" state is sensibly brittle, whatever may be the amount of carbon contained, and that a soft or extra soft metal giving 25 per cent. elongation is not sensibly safer against breaking than the stronger but less ductile kinds of 30 tons to 38 tons tensile strength, and that the latter should be preferred for moving parts, subject to wear from friction, such as piston rods, guide blocks, slide-valve faces, etc., as many accidents to engines on service have arisen from the use of piston rods made of steel of too soft a quality. In all cases the metal must be subjected to the process of double-tempering *(double trempe)*—*i. e.*, a first tempering from a bright cherry red, to effect the transformation of the grain, followed by a second from a dull red, which is more properly annealing, for bringing down the hardness to the required degree, and removing strains producing brittleness. The effect of this process in modifying the fragility and elastic limit in forged steels of the two classes is shown in the following results, obtained by tempering the test-pieces in water at about 170° Fahr.:

	Soft.		Semi-hard.	
	Natural	Tempered.	Natural.	Tempered.
Elastic limit...tons..	12.0	20.3	16 0	26.7
Height of rupture—metres	0.2	2.0	0.2	1.8
Angle of bend—degrees.....	143	153	151	158

In a second series of experiments the bloom was reduced under the hammer to two-thirds of the original section, with the result of rendering it more homogeneous, which without altering the ultimate strength and elastic limit has a very marked influence on the elongation, and not only became larger but also more regular, being for semi-hard steel when

	Forged.	Natural.
Non-tempered—elongation	24–25 %	inst'd of 13–16 %
Tempered "	17–18 %	" 7–11 %
Non-tempered—contract'n,	70–80 %	" 14–24 %
Tempered "	151–163 %	" 22–70 %

The method of double-tempering is now applied at Indret to all forgings for engine work, and with the exception of the larger engine framings, to most of the castings. A further advantage in its use for these is that cracks are more readily seen when the metal is heated, so that there is greater certainty in detecting unsound castings. The tempering plant is capable of handling objects not exceeding 6 metres (19′ 8″) in length. Screw-shafts are received forged and tempered at the makers' works (Creusot and Saint Chamond) subject to the following conditions:

The shafts of steel, either tempered and annealed or double-tempered, must satisfy the following tests: Two sets each of five test-pieces to be taken from slabs cut out of a waste piece of the full size of the shaft and parallel to its length, those for tensile and elastic limits being 100 millimetres (3.937″) long by 13.8 millimetres (0.54″) square, and those for impact 20 millimetres (0.787″) square and not less than 180 millimetres (7.086″) long. These are to be cut to shape cold, and if any of them are unsound others may be cut from the same slabs; but should these be defective the article may be rejected. Three out of the five pieces are to be tested for elastic limits, and incidentally for tensile strength and elongation; but these latter tests are not material. Should the elastic limit of any one be below 28 kilos. (61.73 lbs.) per millimetre (.03937″), or that of the mean of the three below 30 kilos. (66.74 lbs.), the other two shall be tested, when, after rejecting the lowest of the five, the average of the four must not be below 30 kilos. or any one below 28 kilos.

For the impact test the bars are to be

scored on all four sides, at a distance of 100 millimetres (3.937″) from one end, by a cutter of the form of an equilateral triangle of 1 millimetre (.03937″) in the side, made very exactly to gage. When clamped in the holder by a length not less than 80 millimetres (3.15″), the piece must not break under a single blow of a weight of 18 kilos. (39.68 lbs.) falling 3 metres (9′ 10″). Should any one of the three pieces fail, the test is to be extended to the remaining two.

Any article not satisfying the tests specified above may, after re-tempering or annealing, be subjected to a second trial.

These conditions, which are perfectly satisfactory to the manufacturers, are especially valuable as giving a precise idea of the practical value of the material, and have also led to a considerable reduction in the number of test-pieces required in carrying on the current work of the establishment at Indret.

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The Strength of Hollow Bars or I-Beams.

A short time ago we received the following query, by no means the first of its kind, and it seems best to reproduce it verbatim, as questions of this character are often queerly worded. The question is as follows:

"In taking a solid bar of iron and boring a hole through it from end to end, according to mechanical rules, and placing this bar in a horizontal position, with the ends resting upon uprights, and putting a pressure in the center of the bar, will it not bear a greater strain than previous to its being bored?"

For the vast majority of our readers it, of course, should not be necessary to say that a bar of iron or steel or any other material, is never strengthened by cutting away a part of it, either from the inside or the outside. The fact that a bicycle frame is hollow does not insure that it is therefore stronger than it would be if it were solid, for the contrary would be true. There are tubular bridges which carry heavy railroad trains, where, if the same material were concentrated into a single solid square or round bar, it would probably not sustain its own weight, and still less would a suspension bridge hold itself up if its material were made into a single stiff horizontal bar. Stiffness would be conspicuous by its absence in these cases.

While it is always true that to drill a hole through a bar, as proposed by our correspondent, cannot possibly add to its strength in any way, it is also true that a bar with a hole through it may be, and pretty certainly will be, stronger in proportion to the weight of it than the solid bar. It is possible to show how this may be true without going into the mathematics of it at all, or using a single figure except for the dimensions, and even those we need not pay any attention to, as any mechanic's eye will be enough to see the whole thing.

Say that we have a rectangular bar of any length, and measuring 2 inches one way and 1½ inches the other way—Fig. 1. We all know in a general way that if we don't want it to bend or break under a weight when using it for a lever, or a beam, or a bridge, it will be stiffer and stronger if it is set up edgewise, as we have it, than it would be if it was laid down on the flat or broadest side.

We may now imagine our bar to be of the same size outside as before, but to have a hole all through it 1 x 1½-inch—Fig. 2. It would not be easy to cast a bar like this except by casting it with a core; and however it were made, we do not need to tell anyone that this bar would not be as strong as the solid bar, and even if the hole was smaller it would still have a weakening effect.

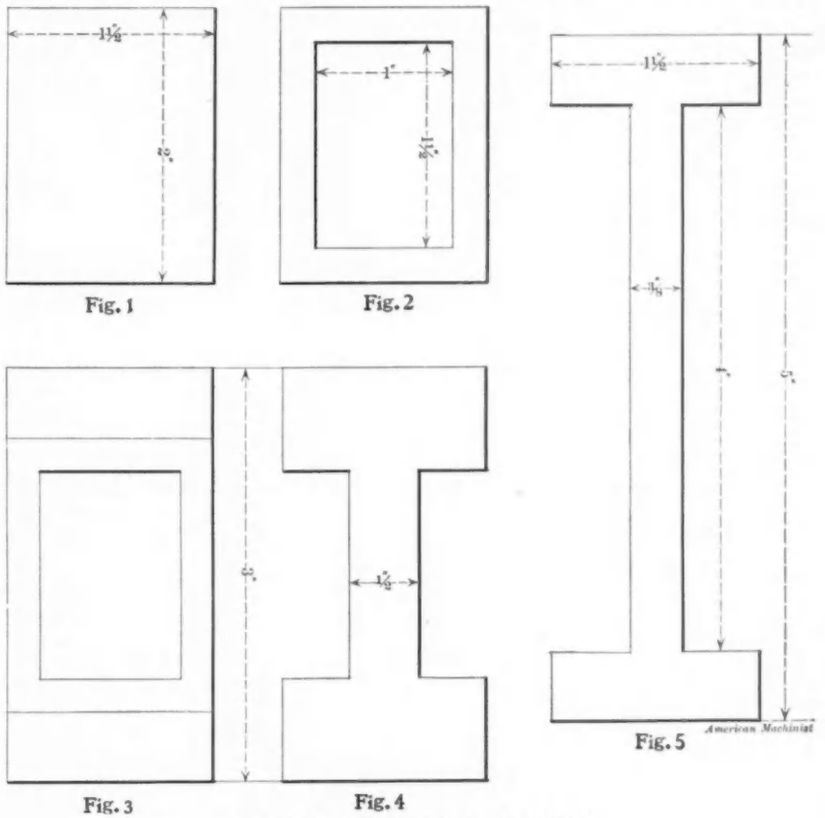

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

STRENGTH IN DIFFERENT SHAPES.

But with the hole the same size as in Fig. 2, if we take the material that has been removed and divide it into two parts, adding one part to the top and the other to the bottom, as in Fig. 3, so that the sectional area and the weight per foot is the same as in our original solid bar, then the case is quite different. For resisting bending strains in a vertical direction, this bar with the hole through it is decidedly stronger than the original solid bar of the same weight. If this bar was laid on a couple of uprights, as proposed, and a weight was placed on the middle, it would be stronger than before, not on account of the removal alone of the material from the interior, but on account of its removal and reapplication where it could do more good. With the weight on the middle, the tendency would be to crush the material along the upper side of the bar and to pull it apart on the lower side, and the material has been applied to strengthen the bar at the parts where these strains were to be encountered. In the middle of the bar there would be no strains lengthwise, either pulling or pushing, so that taking the material away from there would be no loss of strength except in resistance to crushing crosswise, and there would be plenty of strength to spare for that purpose.

Instead of taking the material out of the center and leaving a closed hole there, which cannot be done very well except by casting with a core, the same thing is accomplished by taking one-half of the hole from each side and applying it to the top and bottom, as before, and then we have a rather chunky I-beam, as in Fig. 4. We have made these successive changes by merely cutting away two pieces from the original section of the bar, and adding one piece to the upper side and the other to the lower side of the original bar.

For the purpose of resisting vertical bending strains, the same material may be better arranged as in Fig. 5, where we have something nearer like the commercial I-beam, which theory and practice both approve for such service. This arrangement strengthens the bar in the ver-

tical direction, in which it is to do its work, and where the strength is wanted, but does not strengthen it laterally.

Either Fig. 4 or Fig. 5 would bend sidewise more easily than Fig. 1. A shaft square, round, or of nearly any symmetrical section, with a central hole, is stronger to resist torsion or bending in any direction than a solid shaft of the same weight per unit of length. There are, of course, limits to the application of this principle. The hole could be made so large, and the walls of the shaft so thin, that it would be impossible to keep it in shape.

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The Woonsocket, R. I., Machine & Press Co. have put out a machine by which wool is spun continuously and the venerable mule for wool spinning is to be superseded. The machine can be operated upon any grade of stock and it is said that its twenty-six spindles will spin as much yarn as a mule of 400 spindles, saving floor space, power and labor. It is believed that the introduction of this machine will effect an important saving in the cost of woolen goods.

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The time when the construction of American railroad track was to Englishmen an example of all that was bad has apparently passed. In a discussion now going on in "The Engineer," some English writers go so far as to conclude the American construction to be the best, and editorially the paper concludes it to be the best for our conditions, namely, cheap wood and expensive iron.

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Mr. Jno. L. Stevenson, in the first of a series of articles on "American Blast-Furnace Practice," now being published in "The Engineer," has the candor to say: "There is no possibility of disguising the fact that, whatever we [Englishmen] have done in the past to maintain our metallurgical supremacy, we have been considerably left behind in regard to large outputs in blast-furnace practice."

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We are in possession of facts which justify us in making the absolute statement that ten compressed-air street cars are being constructed for the Metropolitan Traction Co., and that they are to be tried upon the Columbus and Lexington avenue lines of that company. About this time expect numerous demonstrations in the columns of the electrical press to the effect that the thing can't be done.

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The Associated Trade Press and Industrial Press, of Washington, D. C., has compiled a list of the leading machinery dealers in Mexico, Central and South America.

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We have a few hundred of Cox's pulley and gearing computers which will be sent free, while they last, to our readers who apply for them.

▲ ▲ ▲

The German Government will build two battle-ships and five cruisers with triple screws.

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Commercial Review.

NEW YORK, SATURDAY EVENING, JULY 25th.

Iron and Wood Working Machinery.

Domestic trade in machine tools, like that in other lines of goods, is now of a vacation character. It has not subsided completely, and some companies seem to be doing as well as, in the light of the past, the present and the uncertain future, they reasonably could expect. Yet, generally speaking, the market is quiet, flat, and with attention centered upon the future rather than the present.

The disappointing results of the bicycle business, including the actual failures in that line which have already taken place, are sufficient effectually to banish all idea of a repetition of last year's activity in the equipment of bicycle plants, but it would appear that enterprise in this direction has not entirely ceased, for we learn from a single source that six or eight parties have been inquiring for tools for that purpose.

Mr. A. D. Quint, of Hartford, Conn., manufacturer of turret drills, writes us: "My business during the present year, up to May, was 50 per cent. better than during the same period of 1895, most of the increase being for export. For the past two months business has been quiet. Inquiries come in, but we find it harder to make sales than during the earlier part of the year. We do not expect much improvement until after Presidental election, and the financial question is settled on a sound basis. Then we think machine tool building, as well as all business, will have a boom."

The Mossberg Manufacturing Co., of Attleboro, Mass., manufacturers of special machinery and jewelers' tools, report to us: "We are running full time at present, although we think the same as many others in our line of business, that the American market is rather quiet. Still we are exporting large quantities of machinery to England, where business seems to be good."

Manning, Maxwell & Moore, of this city, have included in their recent sales 68 lathes, averaging about 14 and 16 inches swing, 7 turret head lathes, a 10 foot Pond boring mill and a 5 foot Pond radial drill. They have just booked a fine order from a foreign country.

We give, anonymously, business opinions from the standpoint of three other machine tool concerns, all having headquarters in New England. One company have been doing as well as it might be supposed that they would in view of the general situation. Although there is no definite outlook and little visible source of orders, yet by the end of the month a fair volume of business gets upon their books, somehow. A calculation as to the amount necessary to be taken in each month in order to get along was made about May 1st, and June and July are running ahead of their estimates. The company did an exceedingly good business during the last half of last year, although they did not adopt the policy of entering upon bicycle tool manufacture. They have just received an order from London and expect to book some from Germany very shortly.

Another company writes us: "The present situation is such that we think the less said the better. We do not secure much pleasure or satisfaction in considering it and as to the future or for the business for the balance of the year we are not very hopeful and are inclined to believe that the present depressed condition will last some months longer. There is considerable inquiry for machinery, but upon investigation we find the inquirers are not buyers and in the majority of cases they report that they are posting themselves in reference to the future, and do not intend to increase their equipments until the political situation is cleared up. We are getting more or less orders all the time but owing to heavy competition with others, the prices are very unsatisfactory."

The third machine tool interest has to say that the demand for iron working machinery in this country is very limited, both in New England and the West, there being still a very fair demand from abroad which is keeping most of the shops fairly busy.

There is one phase of the situation which ought to furnish a good deal of compensation in the minds and in the pockets of manufacturers for the quietness of domestic trade, and that is the export business. It is pretty generally acknowledged that this is, or has been, looking up; which is confirmed by the latest monthly summary published by the United States Treasury Department, showing that the domestic exports of "machinery"—not including engines—for May, 1896, have amounted in value to $1,478,432, as compared with $962,738 for the corresponding month last year, showing an increase of 53½ per cent; and for the eleven months ending wtih May, 1896, $13,430,836, against $10,475,069 for the eleven months ending with May, 1895, an increase of 28 per cent.

Two explanations may be offered for an improvement in export trade: that the manufacturers, finding less than usual to tempt them at home, are turning their attention to foreign countries as a more promising field; and that the foreign demand is increasing per se. Each reason, evidently, is true in part. There exists now in Europe a furor over bicycle making and this may mean a very good thing for American manufacturers if it is availed of.

Woodworking machinery is out of season and rather inactive, yet more than one

concern reports, for this quarter, an amount of business which may be worth mentioning in such a month as July. The best district, at present, is said to be New England. Collections are difficult, but that is an old story. The Connell & Dengler Machine Co., whose main office is at Rochester, N. Y., have received an order for one of their 60-inch band resawing machines from J. C. Orr & Co., of Greenpoint, Brooklyn. A short time ago they sold one to Young & Girard, also of Brooklyn.

The iron market is extremely dull, but the production of pig iron is being so curtailed that it is approaching the consumption point, if it has not already passed below.

The other metals have been listless during the past week and prices are generally lower, as may be noticed from the quotations.

Quotations.

New York, Monday, July 27th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $13 00
No. 2 foundry, Northern	11 75 @ 12 25
No. 2 plain, Northern	10 75 @ 11 00
Gray Forge	10 75 @ 11 00
No. 1 foundry, Southern	11 25 @ 11 50
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 50 @ 10 75
No. 1 soft, Southern	10 50 @ 11 00
No. 2 soft, Southern	10 50 @ 10 75
Foundry forge, Southern	10 00 @ 10 25

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.10 @ 1.20c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 11 @ 11⅛c.; casting copper, 10⅝ @ 10⅞c.

Pig Tin—For 5 and 10-ton lots, 13.45 @ 13.55c. f. o. b.

Pig Lead—In carloads, 2.92½ @ 2.95c.

Spelter—In carload lots. New York delivery 3.95 @ 4.00c. for standard Western brands.

Antimony—Cookson's, 7 25c; Hallett's, 6.50c.; Japanese, 6.45c.

Lard Oil—Prime city, present make, 40 @ 42c.

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Manufactures.

J. Mundell & Co., Elora, Ont., will rebuild their furniture factory.

A $30,000 system of waterworks will be constructed at Kaslo, B. C.

The Diamond Wheel Company, Baltimore, Md., will go into the manufacture of bicycles.

H. N. Thayer, Erie, Pa., will erect a large plant for the manufacture of wagon wheels, etc.

The Scranton Milling Company, Scranton, Pa., will buy new machinery to equip their plant.

The Union Iron and Steel Company of Youngstown, O., are making extensive improvements.

The villagers of Sweetsburg, Que., are discussing the construction of a system of waterworks.

Three open-hearth steel furnaces will soon be constructed by the Shoenberger Steel Company of Pittsburg, Pa.

The New Holland Silk Company, New Holland, Pa., will erect a large factory, and will put in a line of machinery.

The Keystone Cycle Company, Reading, Pa., will erect a plant for manufacturing bicycles, and will buy new machinery.

R. R. Severn, Pottsville, Pa., will erect a large steam laundry and will purchase a line of new and improved machinery.

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Compt. dftsman. wants pos'n. E. P., Am. Mach.

Mechanical draftsman wishes position. Address Box 240, American Machinist.

Exper'nced. pattern maker wishes situation; electric work preferred. Address Box 228, Am. Mach.

Exp. mechanical draftsman wants position; good refs. Max Brauner, No. 65 St. Mark's Place, N. Y.

Pattern maker, first-class all-round mach. hand, A 1 references, wants position. Box 238, Am. Mach.

Wanted—By the Nellis Belt Fastener Co., 284 Pearl street, New York, hustling salesmen on their patent fastener and pulley covering.

Position wanted by experienced man as engineer or machinist; good workman and thoroughly reliable. Box 231, American Machinist.

Wanted Situation—Toolmaker (30) to grow up with mfg. concern; has had ch rge of manufacturing of light machinery. Box 227, Am. Machinist.

A man of experience to superintend piece work, keep time and figure costs; state experience and salary expected. Box 235, American Machinist.

Wanted—Position as foreman in machinery and jobbing foundry; 17 years' experience; sober, industrious, a hustler; ref. A 1. Box 236, Am. Mach.

Practical mach. designer, of 6 years' mach. shop and 8 years' drawing room experience on general and special machinery. Add. Box, 221, Am. Mach.

Wanted—Position by practical foreman in manufacturing line; 6 years' experience in handling help on small and medium work; good references. Box 237, American Machinist.

Wanted—Position in line of mechanical engineering by graduate in technical college; has had shop practice in general machine work. Address H. H., 1518 Spring Garden Street, Philadelphia, Pa.

Wanted—Situation by toolmaker to take charge of screw mach. work; 15 years' experience with large electric concern; can handle men and tools with best results. Address Box 218, Am. Mach.

Good all-round machinist, young, ambitious and fully experienced in overhauling printing presses, desires position; would like to start where there is prospect of advancement. Box 216, Am. Mach.

Wanted—Position by a Stevens graduate; exp. in drafting; thoroughly exp. in indicator work and testing; position with consulting engineer preferred; best references. Box 230, Am. Machinist.

First-class planer hand, 17 yrs.' experience building lathes, planers, drills, etc., wants position to take charge; has had charge in shop of 175 machinists; age 31. Box 225, American Machinist.

Wanted For Ohio—One first-class planer hand, three first-class machinists; men only used to bldg. machine tools need answer; state experience, wages, etc. Address Box 232, Amer. Machinist.

Situation wanted by mechanical dftsmn., 10 yrs.' experience in pumping engine, locomotives, stationary engines and general machy.; college education and used to figures. Box 234, Amer. Machinist.

Wanted—Position by experienced mech'l dftsmn., technical graduate; experienced in steam, power transmission and general machinery; good mech'l ideas; ref. if desired. Box 223, Amer. Machinist.

Wanted—A No. 1 man for high grade brass work; one who can make instruments and tools of all descriptions; a permanent position for the right man. Address Post-office Box No. 370, Salt Lake City, Utah.

Mech. eng. wants position; 21 years' experience in marine, Corliss and gen. eng. and boilermaking; 10½ years shop and drawing office; 8½ years supt. and asst. mgr.; 2 years sea-going experience. Box 217, American Machinist.

Superintendent of large factory wishes to change; am in charge of 200 men; practical tool maker and draftsman; can invent and design special watch, clock and auto. machy.; prefer elect. mfg.; good ref.; correspondence solicited. Box 233, Am. Mach.

Mechanical draftsman (22), having been with well-known foundry 4 years, wishes to change and take a position as dftsman. or a position where a knowledge of draw'gs is necessary; can estimate wghts.; salary, 15 dollars per week. Box 224, Amer. Mach.

Superintendent will soon be open for engagement and wishes to correspond with parties requiring the services of a man of thoroughly practical and executive ability; extensive experience in the manufacture of elect'cal apparatus. Box 229, Am. Mach.

(Continued on page 22.)

The Susquehanna Silk Mills, Sunbury, Pa., will erect a plant and will purchase a line of new machinery. Capital, $150,000.

Edwin H. Fitler & Co., Philadelphia, Pa., cordage manufacturers, have increased their capital stock and will put in more machinery.

Baker Forge Company of Ellwood City, Pa., are in the market for machinery. Their intention is to double the capacity of the works.

The Enterprise Brass Manufacturing Company, Louisville, Ky., will enlarge their facilities by the purchase of some new machinery.

The Rawson Manufacturing Company, Philadelphia, Pa., will erect a large plant and buy machinery of the latest improved patterns.

H. W. Hartman, Ellwood City, Pa., will erect a plant for manufacturing steel billets for bicycle tubing. He will put in new machinery.

The Kentucky Military Institute are looking for machinery for a manual training school. Col. C. W. Fowler, of Lynden, Ky., is superintendent.

E. A. & H. W. Russell, of Cambridge, Mass., are building a new candy factory and will install electric motors to do the manufacturing with.

The Buhl Company, Sharon, Pa., will erect a plant in the near future, and will purchase a full line of machinery for manufacturing steel goods.

E. A. Wheeler, Sharon, Pa., will erect a plant to manufacture corrugated steel roofing, and will buy new machinery of the latest improved type.

It is reported that the Carnegie Steel Company, Pittsburgh, Pa., will add the manufacture of bicycles to their business and will want new machinery.

The Pennsylvania Phosphate Company, East Waterford, Pa., will erect a factory and will put in a boiler, engine, set of rolls, screens, elevators, etc.

A new power house is being erected at the Framingham, Mass., State Normal School, and will install apparatus to heat and light all of the school buildings.

At a recent meeting of the stockholders of the Waltham Screw Company, Waltham, Mass., it was decided to erect a new factory and install new machinery.

In order to supply the demand for their drills the T. & B. Tool Company, Danbury, Ct., is running part of the plant nights, two sets of men being employed.

The Lebanon Fuel and Illuminating Company, Lebanon, Pa., has just been incorporated. Capital, $60,000. The company will buy machinery to equip their plant.

Albert Duncan, chairman of Commissioners in Council of the Petrolia (Ont.) Waterworks, is asking for bids for a set of pumping engines for the new system of waterworks.

The Franklin Steel Casting Company will double the capacity of their plant in all departments. They have orders ahead for 32,000 M. C. B. couplers, beside a large general casting trade.

New car and repair shops will be erected at an early date at Dubois, Pa., by the Buffalo, Rochester & Pittsburg Railway. They will be on an extensive scale, giving employment to over 200 men.

The Excelsior Machine Company of Buffalo, N. Y., manufacturers of steel balls, are doubling their present works, and will be able to turn out 200,000 balls per day, as soon as they get their new machinery in place.

Articles of incorporation have been granted the Bloomsburg Elevator and Machine Works, with headquarters at Bloomsburg, Pa. Capitalization, $50,000. A. Z. Schock, of Bloomsburg, can give information.

The Thomas G. Plant Shoe Company are to erect a large factory at Roxbury, Mass., and will fit it up with the latest and most improved machinery for ladies' work. Thomas G. Plant, of Lynn, Mass., is manager.

The new Whitmore-Dean automatic purifiers, for prevention of the scaling of boilers, will be manufactured by the Filer & Williams Manufac-

MANUFACTURES—Continued.

turing Company of Youngstown, O., who recently started in business. They will put in new machine tools.

The transfer of freight cars to and from the junction of the N. Y., N. H. & H. R. R. to the works of the Bigelow Company, the National Pipe Bending Company, the New Haven Rolling Mills and other establishments at New Haven, Conn., will hereafter be done by an electric locomotive. A similar plan is followed at the Taftville Cotton Mills.

The Grand Trunk Railway Company of Canada some time ago arranged to concentrate their car building and car repairing shops west of Toronto, at London. That city gives them a bonus of $100,000, and the agreement has been signed. Plans for the new shops will soon be ready, when tenders for the construction will be called for. They are to be equipped with a full line of up-to-date machinery, and a staff of 400 to 500 men.

The Rhode Island Locomotive Works closed down on the 20th for an indefinite period. The concern is in the hands of a committee of its creditors, which committee ordered the shut down. An attempt will be made to put the company on its feet by the enlistment of additional capital, but the general opinion seems to be that an entire reconstruction of the works would be necessary to make the plant a paying one in competition with modern establishments.

An application has been made to the courts at Wilmington, Del., for a charter creating the Kelley Match Machine Company. Match machinery only will be manufactured. The capital stock is stated at $50,000, which will be increased to $250,000, if necessary. The incorporators are Alexander Kelley and W. B. Clerk, of Wilmington, Del.; E. F. G. Gaynor and George A. Kelley, of New York; J. Edward Addicks, of Claymont, Del., and J. Newell Ball, of Bridgeville, Del.

The Bickford Drill Company, Cincinnati, O., write us under date of July 17th: "On the 10th of the present month we moved temporarily to the corner of Front and Lawrence streets, and the new building which we are putting up for our business is now in progress at our old site, corner of Front and Pike streets. The building will be 75 feet wide, 125 deep, four stories high, with necessary provisions and arrangements for a more perfect production of our product. The time occupied in the construction will be about three months."

Three new manufacturing establishments are under process of construction at East Rome, N. Y. J. S. Haselton recently purchased thirty-four acres of land east of Mill street, of J. I. Sayles, and it is on this land that the buildings are being erected. The first will be occupied by the Rome Manufacturing Company, which has outgrown its present quarters and will put in heavier machinery. The building situated next to it will be used by the curtain pole factory, and the third will be leased to any manufacturing company that can be induced to locate here. The buildings will all be steel-roofed and practically fireproof. A power plant will be centrally located. The land lies adjacent to the New York Central Railroad, with a switch at a convenient point for shipping at the head of Railroad street.

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9"x12", 6"x9" and 3½"x6". We recommend the 6"x9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

Armstrong Bros. Tool Company, Chicago, have issued a new catalog of their patent tool holder. It is 3⅜ x 6¼ inches.

John Platt & Co., 97 Cedar street, New York, issue a pamphlet descriptive of the "Thornycroft"

(*Continued from page 22.*)

Help Wanted.

(*Continued from page 21.*)

Mech. eng. with tech. education received at best institute in Mass. desires a change; thoroughly practical in design of engs., pumps, ice mach., etc.; well acq. with compet. meth. of well-equipped and successful shops. Box 222, AMERICAN MACHINIST.

Iron moulder, age 40; late foreman; married; sober and steady; good workman, either green or dry sand; have been out of employment four months; would like employment as workman; will any brother foreman give it me, either in Jersey or New York States? Box 220, AMERICAN MACHINIST.

Mechanical engineer, graduate in civil engineering from a European college, wants situation where careful work is appreciated; experienced in transmission and heavy general machinery, turbines, power installations, hydraulic and modern structural work; a chance to secure the services of a man who, with thorough theoretical knowledge, combines 18 years' practical shop and office exp.; references as to ability. Box 226, AMER. MACH.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O

Calipers & Gauges. F. A. Welles, Milwaukee, Wis

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

For sale—Buckeye Eng., pract. new, 11x14, rating 70 to 90 H.P., $450.00. S. M. York, Cleveland, O.

Light and fine mach'y to order; models and elec trical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O

Auction—50,000 ¼ and ⅛ hex. head cap screws to be sold to the highest bidder. Send stamp for samples. J. L. Lucas, Lynn, Mass.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co. Middletown, Ohio.

Shop room with power; no interference; use of tools and machines; $10 per month; temporarily or permanent. Address Box 239, AMER. MACHINIST.

Inventors—Patents procured, construction, drawings and inventions perfected by Wm. G. Nelson & Co., mech. engrs. & pat. attys, 108 Fulton st., N.Y.

Cheap for quick sale.—1 Wheeler Planer 42x42, very heavy, first-class condition; cost $1,900, will sell for $650. Butterworth & Lowe, Grand Rapids, Mich.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call or get list 17 B. The Garvin Mach. Co., 440 Canal st., N. Y.

Notwithstanding

the times, we are doing some business. Shop owners must save money—can't make it now.

Our Tools Save Money

Ask for July Catalog. Bullard Machine Tool Co., Bridgeport, Conn., U. S. A.

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SCHOOL OF MINES,
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The author has probably had more experience with the manufacture, care and management of Engines of the above type than any other man connected with the subject. *ADVANCE ORDERS SOLICITED.*

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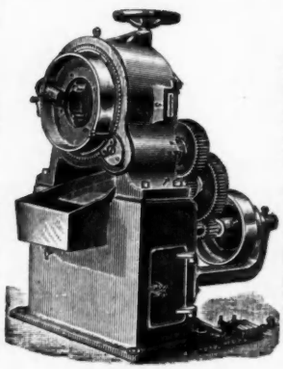

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Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

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Thomas A. Edison

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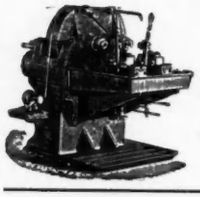

Automatic Solid Die Bolt.
THREADING MACHINES.
Two Styles. Four Sizes.
Send for Catalogue "A."
WEBSTER & PERKS TOOL CO.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.

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Ingénieur ayant références et très grandes relations accepterait

Répresentation à Paris,

Écrire Bolige 29 passage opéra, Paris.

The Halsey Pneumatic Pump.

For pumping water by direct air pressure.

SIMPLE, AUTOMATIC, PERFECT.

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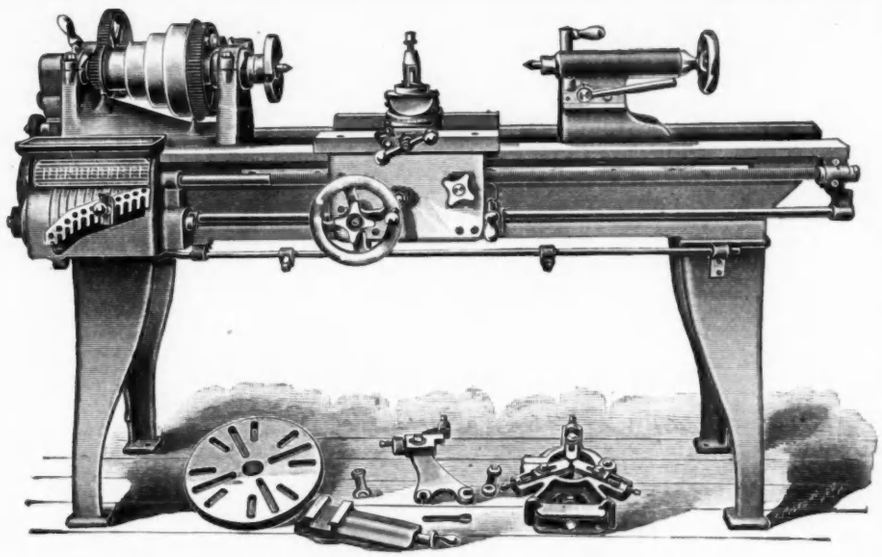

14 in. x 6 ft. Hendey-Norton Lathe with Improved Automatic Stop.

THIS Lathe COMBINES the LATEST and BEST Improvements. Automatic Stop. It is Simple, Durable, Indispensable. It will AUTOMATICALLY STOP the Carriage in EITHER direction. It is equally efficient whether FEEDING or THREAD-CUTTING. Running up to a shoulder, boring to BOTTOM of holes, or INTERNAL THREAD-CUTTING.

No danger of spoiling either tool or work. It is a safeguard against accidents, in either direction.

Feeds — It has all feeds in daily use with simple movement of lever.

Threads — It has all threads in daily use with simple movement of lever.

Carriage — The carriage reverses in Apron. No slamming of Countershaft. There is no comparison between this Lathe and the old style or common Lathe. Quick work, rapid changes, satisfactory results. BUY THE BEST.

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TORRINGTON, CONN.

European Agents:

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21 Cross Street, Finsbury, London.

SCHUCHARDT & SCHUTTE,
59 Spandauerstrasse, Berlin.

SOLLER, Basel, Switzerland.

NEW CATALOGS.—Continued.

water-tube boilers, for which they are agents in this country. It is 7⅜ x 9¾ inches.

The Boston Belting Company issue a neat catalog of 128 pages, showing the various goods manufactured by them, and also containing valuable information as to running, splicing, or lacing rubber belts, with various useful tables, etc. Size, 6½ x 3¾ inches.

We have received a catalog illustrating and describing the universal cutter, reamer and tool grinder, made by Köping's Mekamska Verkstads Aktiebolag, Köping, Sweden. The tool is an interesting one; the catalog is in good English, and is standard size—6 x 9 inches.

The National Chuck Company of 39 Cortlandt street, New York, have issued a catalog describing and illustrating the line of chucks made by them. All information in reference to weights, dimensions, etc., is given in most convenient form and new chucks and appliances are shown. It is 5¾ x 7 inches.

Theo. Alteneder & Sons, 645 Ridge avenue, Philadelphia, issue an illustrated catalog of "Imperial German" drawing instruments. These instruments are constructed upon the same principle as the well-known Alteneder instruments, but are made in Germany instead of in the Alteneder shops here. The catalog is standard size, 3½ x 6 inches.

The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., are sending out pamphlets, in which are illustrated various machines made by them, which are specially adapted for use in bicycle factories, and these include not only a variety of presses and special machinery for such work, but also furnaces, line-shafting, hangers, pulleys, couplings, etc.

The Coshocton Foundry Company, Coshocton, O., send us a pamphlet illustrating and describing the "W. & W." Automatic Lubricating Box for horizontal shafting and other machinery bearings. This is a box containing an oil chamber, into which small blades attached to the shaft project and throw the oil into suitable channels for circulation. The pamphlet is 3½ x 6½ inches.

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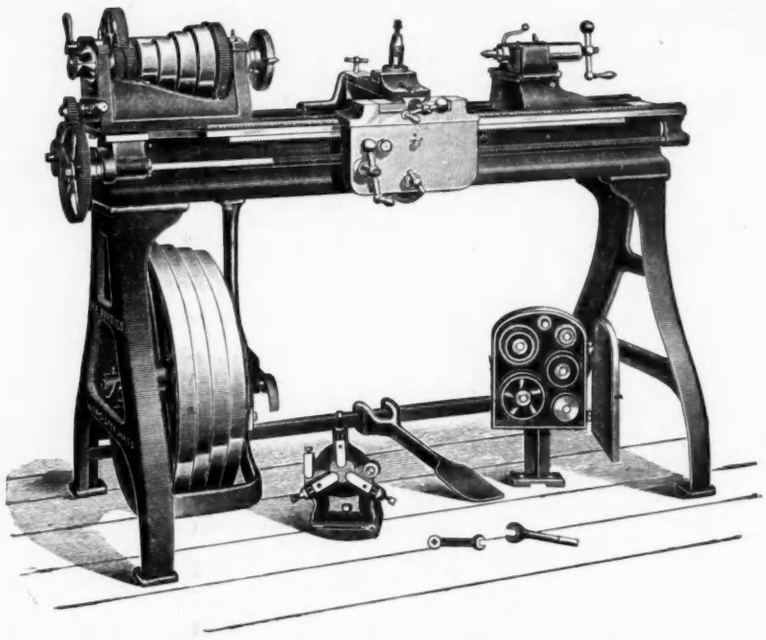

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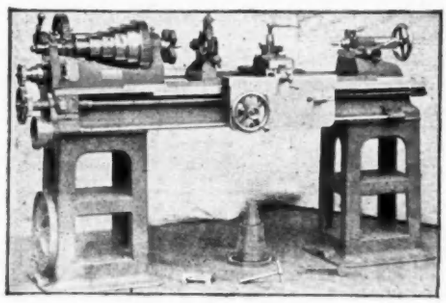

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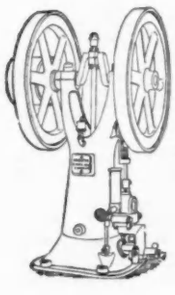

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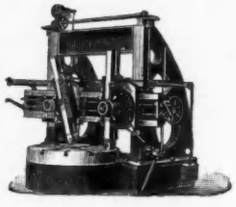

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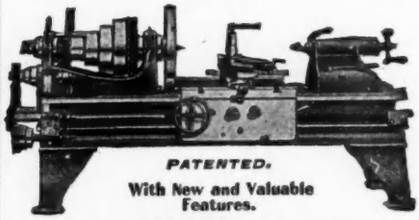

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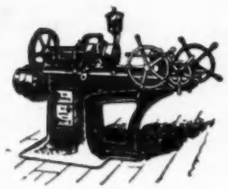

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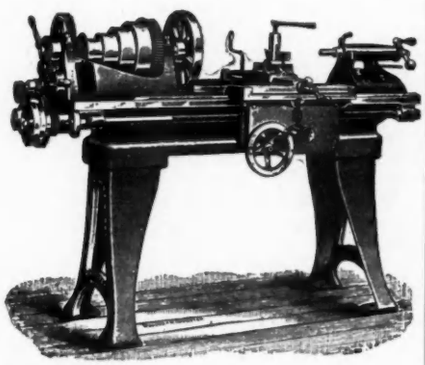

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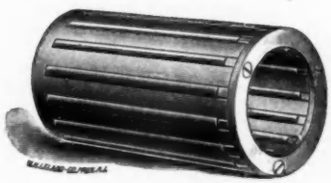

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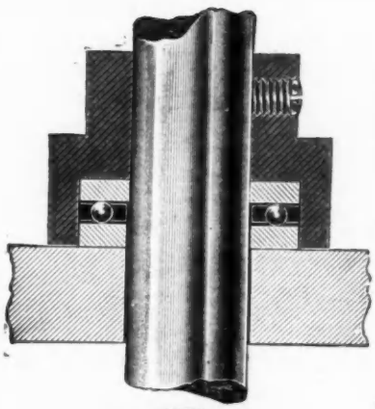

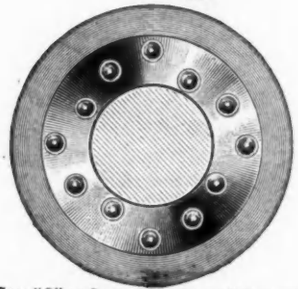

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Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago Ill.
Dietz, Schumacher & Boye, Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Barker & Co. Cleveland, O.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., E., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Montgomery & Co., New York
Mossberg Mfg. Co., Attleboro, Mass.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Quint, A. D., Hartford, Conn
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley & Ware, South Bend, Ind.
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drill Gage.

Wyke & Co., J., East Boston, Mass.

Drill Rods.

Abbott, Wheelock & Co., Boston, Mass.

Drills, Twist.

Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Drop Forgings.

Transue & Williams, Alliance, O.
Wyman & Gordon, Worcester, Mass.

Dynamos.

Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.
Roth Bros. & Co., Chicago, Ill.

Dynamo Brushes.

Wirt, Charles, Philadelphia, Pa.

Electric Machinery.

Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.

Elevators.

Albro-Clem Elevator Co., Philadelphia, Pa.

Emery Wheels.

Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Sterling Emery Wheel Co., Tiffin, O.
Strelinger & Co., Chas. A., Detroit, Mich.

Engines, Gas and Gasoline.

Norman Co., J. J., Chicago, Ill.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Springfield Gas Engine Co., Springfield, O.
Webster Manufacturing Co., Chicago, Ill.
Wolverine Motor Works, Grand Rapids, Mich.

Engines, Steam.

Ames Iron Works, Oswego, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Keystone Engine & Mach. Works, Phila., Pa.
Sturtevant Co., B. F., Boston, Mass.
Weston Engine Co., Painted Post, N. Y.
Wetherill Machine Co., James P., Chester, Pa.

Feed Water Heaters and Purifiers.

National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

Files.

Arcade File Works, New York.
Besly & Co., Chas. H., Chicago, Ill.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Strelinger & Co., Chas. A., Detroit, Mich.

Fire-proof Construction Materials.

Johns Mfg. Co., H. W., New York.

Forges.

Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Boston, Mass.
Wilkinson Co., The, Chicago, Ill.

Friction Cones.

Evans Friction Cone Co., Boston, Mass.

Furnaces.

American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

(Continued on page 28.)

BUYERS' FINDING LIST—Continued.

Gages.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

Gauges, Pressure Recording.
Schaffer & Budenberg, Brooklyn, N. Y.

Gear Cutters.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant, Geo. B., Lexington, Mass.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn.

Gears.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

Governors.
Replogle Governor Works, The, Akron, O.

Graphite.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grinding and Polishing Machines.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Norton Emery Wheel Co., Worcester, Mass.
Place Machine Co., George, New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Wells Bros. & Co., Greenfield, Mass.

Grinders, Center.
Barker & Co., William, Cincinnati, O.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Trump Bros. Machine Co., Wilmington, Del.

Grinding Machine, Cock.
Foote, Barker & Co., Cleveland, O.

Grinding Machine, Cutter.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Foote, Barker & Co., Cleveland, O.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Grinding Machines, Universal.
Brown & Sharpe Mfg. Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

Hack Saws.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Q. & C. Co., Chicago, Ill.
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.

Hammers, Drop.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg Mfg. Co., Attleboro, Mass.
Stiles & Fladd Press Co., Watertown, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Hammers, Power.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Hill, Clarke & Co., Boston, Mass.

Hoists.
Harrington, Son & Co., E., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
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Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Keyway Cutter.
Baker Bros., Toledo, O.

Lathes (see also Turret Lathes).
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.

(Continued on page 29)

D. SAUNDERS' SONS,
MANUFACTURERS OF
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Steam and Gasfitters' Hand Tools,
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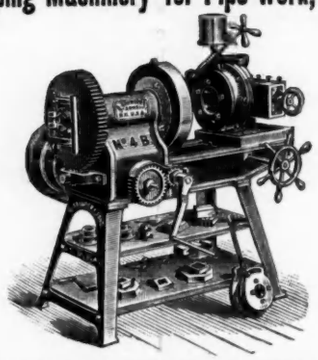

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With from 2 to 12 Spindles, will drill and tap at same operation.
ESPECIALLY ADAPTED FOR BICYCLE AND ELECTRICAL WORK.
Only the spindle in use revolves. All tools work to same point in center of table.
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OVERHEAD TRAMWAY
for Mills, Foundries, Machine Shops, or for Merchandise. *Send for Book.*
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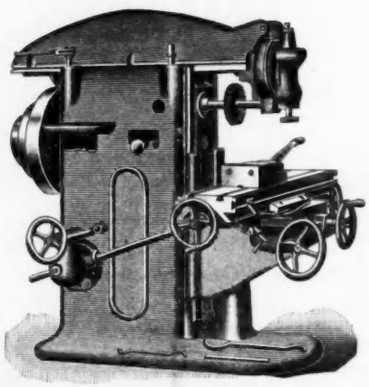

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SPEED LATHES, SLIDE RESTS, MANDRELS, etc., Adjustable and Solid.
Reamers.
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57 inch x 20 feet Planer.
48 inch x 18 feet Sellers Planer.
36 inch x 26 inch and 24 inch Planer.
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32 inch x 20 feet Pond Lathe.
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15 inch Gould Shaper with Rack Cutting Attachment.
Large Stock of Lathes, Drill Presses, Bolt and Pipe Cutters, Steam Hammers and General Machinery; Corliss, Automatic and Slide Valve Engines & Boilers.
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We have just secured the following outfit, comprising the latest and most improved tools for manufacturing. None of the *tools* are more than *one* (1) *year* old and many of them *have not been used*.
If in the market for below-mentioned tools, we can save you from 25 to 50 per cent. of the cost of the tools new. Don't fail to write for full particulars and prices.
50 x 60-inch x 18 feet Fifield Triple-Geared Lathe.
28-inch x 16 feet Prentiss Standard Lathe. Heavy pat.
24-inch x 16 feet Prentiss Standard Lathe. Heavy pat.
Two 20-in. x 10 ft. Prentiss Stand'd Lathes, C.R. & P.C.F.
20-inch x 8 feet Prentiss Standard Lathe, C.R. & P.C.F.
19-inch x 10 feet Prentice Bros. Lathe, C. R. & Taper.
17-inch x 8 feet Prentice Bros. Lathe, C. R. & Taper.
Two 17-inch x 6 feet Flather Lathes, F. Gib & P. C. F.
Three 15-inch x 6 feet Flathes Lathes, P. Gib & P. C. F.
14-inch x 6 feet Windsor Lathes, R. & F. R. & P. C. F.
14-inch x 5 feet Windsor Lathe, R. & F. R. & P. C. F.
16-inch x 8 feet Fay & Scott Patternmakers' Lathe.
13-inch x 6 feet Flather Speed Lathe.
No. 0 Bickford Radial Drill, with Universal Table.
30-inch Prentice Bros. Drill, with Friction Pulleys for tapping.
21-inch Prentice Bros. Drill, Back Gears and Wheel and Lever Feed.
20-inch Prentice Bros. Drill, Wheel and Lever Feed.
20-inch Snyder Drill, Wheel and Lever Feed.
32 x 32-inch x 8 feet L. W. Pond Planer, with two heads on cross rail.
32 x 32-inch x 8 feet Flather Heavy Planer.
18-inch Flather Improved Crank Shaper.
22-inch Prentiss Friction Shaper.
No. 2 Cincinnati Universal Tool-room Miller. Latest pattern.
No. 13 Brainard Tool-room Miller, Back Geared.
No. 2 Cincinnati Plain Back-Geared Miller; 12-in. centers.
22 x 22-inch x 5 feet Ingersoll Slab Miller.
14 x 14-inch x 8 feet Beaman & Smith Slab Miller.
Ames' Latest Pattern Lincoln Miller.
No. 3 Landis Universal Grinding Machine, 10-in. swing.
No. 3 Landis Universal Grinding Machine, 12-in. swing.
No. 4 Vulcan Emery Grinder, on Stand and Countershaft.
Nearly all of the above tools have extra attachments, chucks, etc., which would take too much space to specify. There is also in above plant, a lot of small tools, reamers, drills, vises, milling machine cutters, pulleys, shafting, hangers, belting, overhead railway, chain, hoist, etc., etc.
We also have in our storehouse a large stock of both new and second-hand machinery on which we can make very low prices.
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LOW PRICES BEFORE REMOVAL.

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Putnam Machinery Co's., 48 in. x 16 ft.
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D. W. Pond, 30 in. x 6 ft.
Pratt & Whitney, 24 in. x 7 ft.
Hendey, 20 in. x 5 ft.
Hendey, 16 in. x 4 ft., Friction.

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Fifield, 38 in. x 18 ft., good as new.
Waterman, 32 in. x 18 ft., good as new.
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Putnam, 24 in. x 12 ft.
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Pond, 20 in. x 15 ft.
New Haven, 20 in. x 8 ft.
Blaisdell, 15 in. x 6 ft.
Reed, 14 in. x 6 ft.
Reed, 12 in. x 5 ft.

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Barnes Sensitive Friction.
Prentice, 20 in., Hand Feed.
Prentice, 20 in., Automatic Feed.
Snyder, 22 in., Automatic Feed and Back Gear.
Ames, 24 in., Automatic Feed and Back Gears.

RADIAL DRILLS.
Latest Pattern, 72 in. swing, good as new.
Warren Universal, 5 ft. arm, complete.

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Hendey, 15 in. Friction.
Prentiss, 16 in. Crank.
Improved, 22 in. Triple Geared.
Hendey, 24 in. Friction.
Trav. Head, 14 in., Fitchburg.
Trav. Head, 14 in., Pratt & Whitney, extra heavy.

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Several Improved Tools out of a shop just bought out.

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1 9 x 9 Greenfield Vertical Engine.
1 Vertical Boiler 36 in. x 7 ft.
1 Clipper Vertical Engine, 5 H. P., combined with 6 H. P. Vertical Boiler.
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1 " 3 " "
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BEFORE REMOVAL
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10 ft.-46 ft. Vertical Boring and Turning Mill.

29 in. x 13½ ft. Engine Lathe.
26 " 20 " " "
37 " 30 " " "
51 " 18 " " "
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36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.
Cranes, Blower.

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13 in. x 6 ft., Ames Mfg. Co.
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14 in.. x 6 ft., Prentice Bros.
16 in x 6 ft., Blaisdell.
16 in. x 6 ft., Dexter.
16 in. x 8 ft., Blaisdell.
18 in. x 8 ft., Fitchburg.
18 in. x 10 ft., Blaisdell.
18 in. x 10 ft., Flather.
18 in. x 6 ft., Muller.
21 in. x 8 ft., Lodge & Davis.
20 in. x 16 ft., G. A. Ohl.
33 in. x 16 ft., Ames Mfg. Co.
33 in. x 16 ft., New Haven.
34 in. x 20 ft., Perkins.

PLANERS.
6 in. x 16 in. x 3 ft., Pratt & Whitney.
20 in. x 20 in. x 5 ft., Haywards.
22 in. x 22 in. x 5 ft., H. C. Pease.
24 in. x 24 in. x 8 ft., Fitchburg.
26 in. x 26 in. x 6 ft., D.W. Pond

SHAPERS.
6 in., Boynton & Plummer.
10 in., Wood & Light, traverse.
10 in., Juengst, crank.
15 in., F. F. Chase, crank.
15 in., Lodge & Davis, crank.

DRILL PRESSES.
10 in., Bench, sensitive.
16 in., Slate, 2 spindle.
No. 2 Garvin, 3-spindle.
3-Spindle Hendey.
No. 2 Pratt & Whitney, 4-spindle.
20 in. Quint Turret Drill.
21 in. Prentice B. G. W. F.
25 in. Pond S. H. W. F.
25 in. Barnes B. G. P. F.
Prentice Bros. Suspension.
9 ft. Holly Radial.

SCREW MACHINES.
No. 5 Brown & Sharpe.
No. 2 1-2 Pratt & Whitney.
19 in. x 5 ft., Windsor.
16 in. x 5 ft., Warner & Swasey.

MISCELLANEOUS.
No. 1 Slate Automatic Gear Cutter
No. 1 1-2 P. & W. Hand Miller.
No. 13 Garvin Miller.
1-Spindle Garvin Profiler.
10 in. Diamond Hand Lathes.
12 in. Garvin Hand Lathes.
13 in. x 6 ft. Reid Hand Lathes.
16 in. Square Arbor Fox Lathe.
4 1-2 in. P. & W. Cut-off Machine.

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3 18 in. x 6 ft., L. & D. Eng. Lathe.
1 19 in. x 6 ft., Fifield Eng. Lathe.
1 20 in. x 11 ft., L. & M. Eng. Lathe with Shafting tool rest.
2 21 in. x 10 ft., Pratt & Whitney.
1 23 in. x 10 ft., White Eng. Lathe.
1 27 in. x 10 ft., Dustin Eng. Lathe.
1 27 in. x 12 ft., Wood & Light.
1 28 in. x 12 ft., Wood & Light.
1 28 in. x 16 ft., Eng. Lathe.
1 30 in. Lodge & Shipley, gear blank and pulley tur. and bor.
1 36 in. x 12 ft., Geared Eng., heavy
1 32 in. x 13 ft., B. & D. triple Gd. S. C. comp. rest.
1 40 in. x 16 ft., geared plain turn'g.
1 48 in. x 18 ft., Gay & Silver.

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1 16 in. x 16 in. x 3 ft., Hand.
2 24 in. x 24 in. x 4 ft., Pond.
2 24 in. x 24 in. x 4 ft., W. & L.
1 24 in. x 24 in. x 7 ft., L. & M.
1 28 in. x 28 in. x 8 ft., G. & S.
1 30 in. x 30 in. x 8 ft., N. & S.
1 32 in. x 32 in. x 10 ft., W. & L.
1 32 in. x 10 ft., Open Side.
1 36 in. x 36 in. x 10 ft., New Haven.
1 36 in. x 36 in. x 18 ft., William Sellers.
1 38 in. x 38 in. x 10 ft., Aldrich.
3 48 in. x 32 in. x 6 ft., Pond, with two heads, new pattern.

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6 Sensitive Bench Drills.
4 Suspension Drills, Pond.
1 10 in. two-spindle Sensitive Drill
1 22 in. back-geared Drill.
1 34 in. back-geared Drill.
1 36 in. Gap Drill, power feed.
1 3-spindle Pratt & Whitney, adj.
2 3-spindle Sensitive, adjble.
1 Quint Turret with tapping attachment, six-spindle.
1 4 ft. arm Radial, Hilles & Jones.

SHAPERS.
1 15 in. Crank.
1 12 in. Traveling Head.
1 9 in. William Sellers, trvg. hd.
1 13 in. Bement & Sons, trvg. hd.
1 12 in. Hewes & Phillips, heavy.

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2 No. 2, Bement & Miles, Hztl.
1 No. 2, Pedrick & Ayer Cyl. Borer.
1 30 in. Stevens Pulley.

SCREW MACHINES.
1 No. 2, Pratt & Whitney, plain.
1 No. 2, P. & W. W. F. Oil Pump
1 No. 3, P. & W., f. c. hd. bk. gu. p. f. to turret slide oil pump.
1 18 in. P. & W., Turret Head Chucking Machine, oil pump.

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1 No. 5, Springfield Water Tool Grinder.
1 No. 2, L. & F. Tool Grinder, two wheels.
1 No. 6, Diamond, surfacing att.
1 No. 3, Universal Cutter Grinder.
1 No. 1, Diamond Univsl. Grinder.
1 Brainard Cutter Grinder, on col.
1 P. & W. Forming Tool Grinder.

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1 No. 4, C. & M., single action.
1 No. 30, Bliss, single action.

MISCELLANEOUS.
1 2-spindle Profiler; Edging Mach.
1 4 in. H. & R. Cutting-off Mach
10 Bench Vises, various sizes.
1 48 in. Gear Cutter.
1 No. 1, Warner & Swasey Vertical Miller.
1 C. & C. Electric Motor, 50 K. W. Generator.
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Forges, Anvils, Chucks, Drills, Shafting, Pulleys, Reamers and Small Tools.

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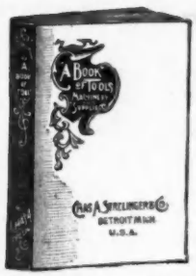

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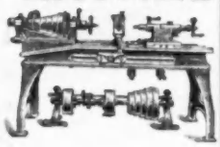

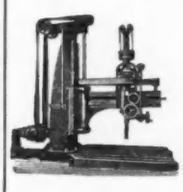

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Lathes—Continued.

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Fitchburg Machine Works, Fitchburg, Mass.
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(*Continued on page 30.*)

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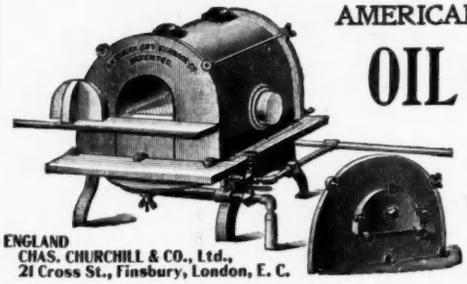

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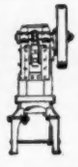

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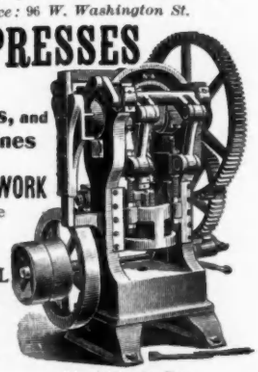

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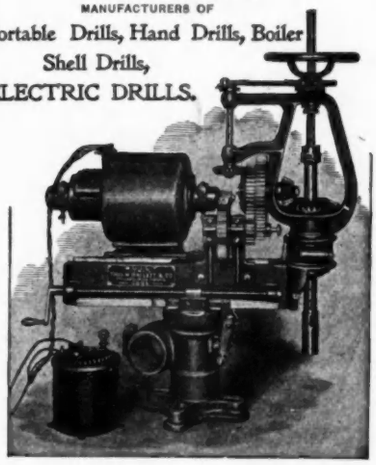

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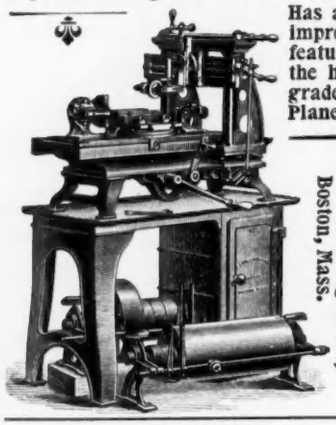

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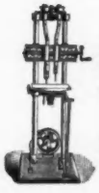

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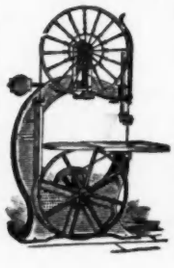

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